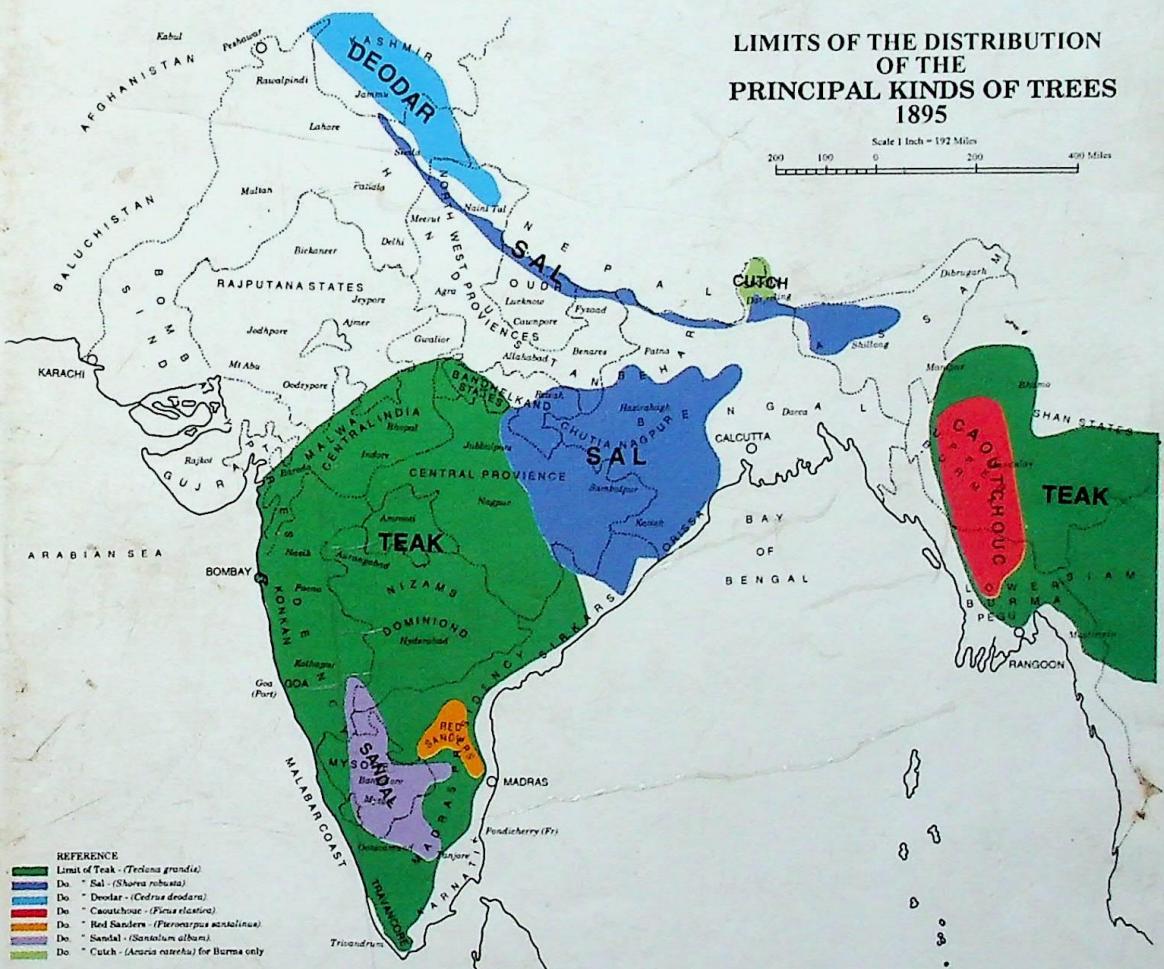


FORESTRY IN INDIA

ORIGINS & EARLY DEVELOPMENTS

Dietrich Brandis



Foreword -

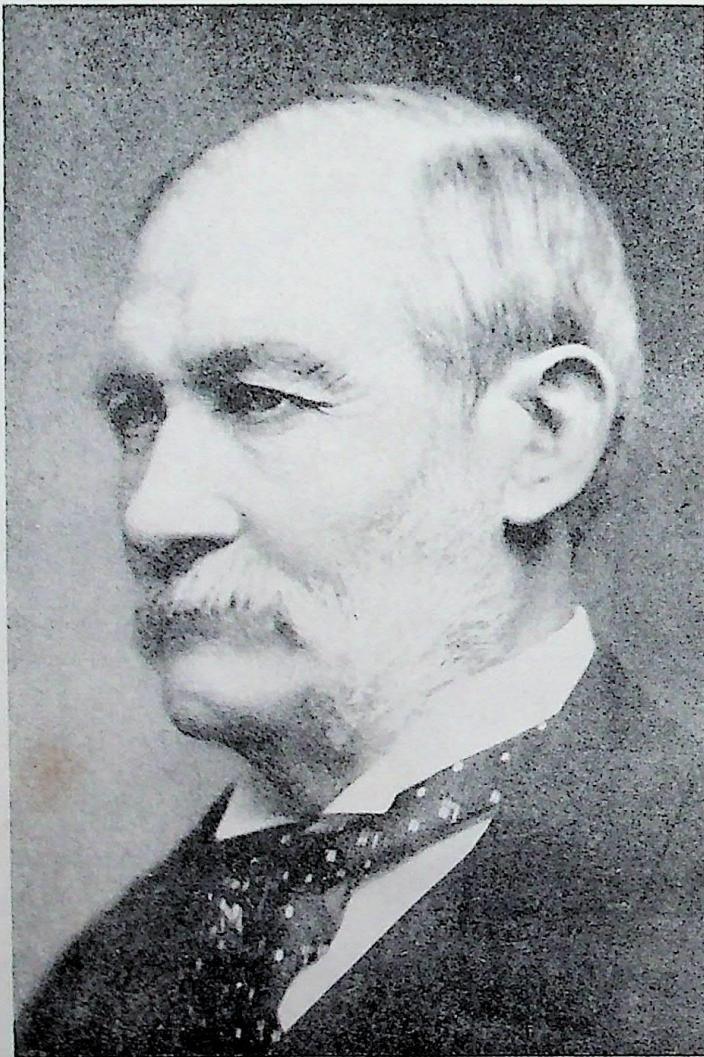
Samar Singh

It is not always that forests were valued as an indispensable asset. In past time they were held to be of little worth, a burgeoning population regarding them as an obstacle to the advance of civilisation as represented by land for graze and cultivation. Recognition of their value comes as late as the closing years of the nineteenth century by a small group of dedicated British and German forest officers, amongst them being the distinguished Sir Dietrich Brandis, FRS.

In this notable compendium of his works is recorded the birth of Indian Forestry. It was a birth not without the difficult pangs of labour for in an age of ignorance to convince officialdom and government even of the inestimable value of forests was not easy. Yet as it is recorded, these selfless men prevailed. Also recorded in considerable detail in this book is a wealth of observation which even today has not lost significance for whilst 'much is taken, much abides' for though forested lands are less, the wisdom of these men is a lasting one. This book is valuable as a historical source and also as a study from which much may be learned even today.

Jammu University
23/3/98

Mookerji IFS (Retd) Collection Jammu



Dr. Radhakrishnan

FORESTRY IN INDIA

ORIGINS & EARLY DEVELOPMENTS

Sir DIETRICH BRANDIS, Ph.D., F.R.S., C.I.F.,
Late Inspector - General of Forests
Government of India

FOREWORD
SAMAR SINGH
SECRETARY GENERAL
World Wide Fund For Nature - INDIA

NATRAJ PUBLISHERS
DEHRA DUN

FIRST PUBLISHED 1897
REPRINTED 1994

ISBN No. 81-85019-39-8

Published by Mrs. Veena Arora for Natraj Publishers, Publications
Division, Dehra Dun and printed at Gaytri Offset Press, New Delhi,
Typeset by Microsoft, Dehra Dun



DEDICATED TO
WORLD WIDE FUND FOR NATURE - INDIA
(WWF-INDIA)
On its
25th ANNIVERSARY

CONTENTS

Preface

Foreword

Chapter One

Distribution of Forests in India 1

Chapter Two

Progress of Forestry in India 36

Chapter Three

Indian Forestry 82

Maps

1. Rainfall & Forest Trees
in India (1890) Facing Page 1
2. Limits of the Distribution of the
Principal Kinds of Trees (1895) Bookend

PREFACE

In this era of global environmental consciousness, no picture of the world's environment is complete without a description of the status and health of India's forests. In the last one hundred and twenty five years, forests in India have undergone tremendous changes relating to extent, status, floral and faunal diversities and legal aspects. Twenty three percent of the country's land is under forest cover and a large area of this cover is densely forested. Forests in our country have withstood the colossal pressures of a growing population, the infinite demands of development and other ravages of time. This has probably been possible due to our pragmatic forest policy and a long standing tradition of scientific management of forests in our country. India is one of the few countries in the world to have its forests managed on sound scientific lines. The founding father of this tradition was Sir D. Brandis who was also the first Inspector General of Forests in India. With his encyclopedic knowledge of the subcontinent's forests, Sir D. Brandis has been immortalised in the annals of Indian forestry. He wrote three books on Indian Forests and Forestry. Each of these is of an infinite academic and historical value, besides being a treasure house of information. The three books - DISTRIBUTION OF FORESTS IN INDIA, PROGRESS OF FORESTRY IN INDIA and INDIAN FORESTRY have been out of print for long. As a result of our special efforts, these works have now been reissued. We hope that this unique publication will be of immense interest to a wide range of readers in the country and elsewhere.



WWF-INDIA
Secretariat
New Delhi

Samar Singh
Secretary General

FOREWORD

It is said that 'scientific forest management' on the Indian sub-continent was started a hundred years ago. The person who actually initiated this development was a German botanist named Dietrich Brandis. In 1855 he was selected by Lord Dalhousie, the Governor General of India, to take charge of the teak forests of Pegu in Burma. For the next 28 years, Brandis dominated the forestry scene on the sub-continent, first by his outstanding work in Burma and then from 1864 as the first Inspector-General of Forests in India, which position he held continuously till his retirement in 1883.

It was during this period that the foundations of organised forest management were laid in India under the guidance and leadership of Brandis. To him and to his immediate successors, Sehlich and Ribben-trop, both of whom were also Germans, goes the credit for the creation and organisation of the Forest Department and for the introduction of methods of management, adopted from the best European schools, to suit the conditions of India. It was also during this period that the first comprehensive forest legislation was enacted to provide for the settlement, demarcation, protection and management of forests. Other important initiatives taken by Brandis included the introduction of the concept of working plans, organised training of forest personnel and the establishment of the Central Forest School at Dehra Dun, which later grew to become the famous Forest Research Institute and Colleges.

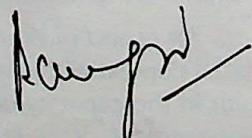
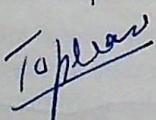
An aspect of Brandis not so well known is his understanding of the social context within which state forestry was to operate in India and his faith in the capacity of the local communities and institutions for forest management. It is in this respect that Dr. Ramachandra Guha has categorised Brandis as one of the early environmentalists in India. To quote his words :

"The Indian Forest Department has been the subject of relentless

less criticism for its authoritarian style of functioning; and yet, in a curious paradox, the founder of the Forest Department had himself anticipated that a narrow reliance on state control and punitive methods of management would lead to great disaffection in the countryside. Keenly aware of rural rights and demands, this man had suggested, a century and a quarter ago, that India adopt a system of forest management based on a collaborative relationship between the state and local communities, in the event, his suggestions were rejected by the colonial government, which preferred to stand by the principle of state monopoly embodied in the Forest Act of 1878. Yet this forester's ideas have a strong contemporary resonance. While terms like 'social forestry', 'community forestry' and 'joint forest management' have come into currency only in the past two decades, the principles they embody would have been readily recognised, and in fact warmly commended, by the first head of the Forest Department in India."*

Apart from being an outstanding administrator, Brandis was a scientist in his own right. During his long stint in India, he not only wrote a large number of very incisive papers and reports but also brought out "The Forest Flora of North-West and Central India", which earned him the fellowship of the Royal Society in 1875. Even after retirement, Brandis continued his work on India and brought out in 1897 a very useful and handy reference book called "Indian Forestry" and then his monumental work titled "Indian Trees", which was published in 1906, just a year before his death.

Most of these valuable works and writings of Brandis are either not easily available or are out of print. It is gratifying, therefore, that some of the early writings as well as his more well known "Indian Forestry" are being reprinted together in this volume. Natraj Publishers, Dehra Dun, deserve all praise for taking the initiative and rendering this valuable service to the interested readers as also the cause of Indian forestry in general.



January 17, 1994

(Samar Singh)

*Foundation Day Lecture dated 15 June, 1993 for the Society for Promotion of Wastelands Development.

Chapter-1

DISTRIBUTION OF FORESTS IN INDIA

IN all countries the character of forest vegetation mainly depends on soil, climate, and the action of man. In India the greater or less degree of moisture is perhaps the most important element in this respect. Moisture and rainfall are not identical terms. Dew and the aqueous vapour, dissolved in the atmosphere, or the water derived from the overflow of rivers and from percolation, are sources of moisture as important for the maintenance of arborescent vegetation as the fall of rain and snow. It would greatly facilitate the labours of the forester, and of the botanist who inquires after the geographical distribution of forest trees, if the amount of atmospheric moisture and the formation of dew during the seasons of the year in different parts of India had been sufficiently studied; but, in the present state of our knowledge, we must be satisfied with dividing India into regions and zones according to the more or less heavy rainfall during the year. The arid region, with a normal annual rainfall of less than 15 inches, occupies a large proportion of the north-west corner of India, from the Salt range in the north to the mouths of the Indus in the south, and from the Suleiman range in the west to the Aravalli Hills in the east. It includes the southern portion of the Punjab, the province of Sindh, the States of Bhawulpoor, Khairpoor, Bikanir, Jessulmir, and the greater part of Marwar. Throughout this vast region, which covers an area equal to that of the kingdom of Prussia, with a population of about twelve millions, the rains are not only scanty but most uncertain. It is not a rare occurrence for several years to pass in succession without any showers, and then there is a heavy downpour, generally in winter, and occasionally in August or September. There are, however, no regular winter or

summer rains. A scanty, thorny scrub on the hills gives ample employment to the botanist, for it is here that the representatives of the Arabian and Persian flora mingle with the vegetation which is peculiar to India; but the work of the forester is mainly confined to the belts of low country along the Indus and its great branches. In Sindh, for instance, the area of forest land at the disposal of the State covers 350,000 acres, all situated on the fertile alluvial soil on both banks of the Indus, some of which is inundated annually by the summer floods of this large river, the remainder being moistened by percolation. In lower and middle Sindh a large portion of these forests consists of the babool (*Acacia arabica*), more or less pure, with a shade so dense that very little grass or herb grows under the trees. In northern Sindh extensive shrub forests of tamarisk, with standards of acacia and a poplar (*Populus euphratica*), cover large tracts along the banks on both sides of the river. As the Indus changes its course from time to time, leaving dry last year's bed, and breaking through at another place, forming a new channel, the fresh banks and islands which are thus thrown up are covered at once by a dense growth of self-sown seedlings of tamarisk, with a sprinkling here and there of the acacia and poplar; while in other places large tracts of old forests are carried away by the encroachments of the river. Outside these forests, a little further inland, but still to a certain extent under the moistening influence of the river, are vast tracts of kundi or jhund, an acacialike tree (*Prosopis spicigera*), *Salvadora*, and an arborescent leafless Caper (*Capparis aphylla*); and further north, in the Punjab, where the rainfall is more regular, and its annual amount approaches or exceeds 10 inches, dry and scanty woods, mainly composed of *Prosopis*, *Capparis*, and *Salvadora*, cover a vast extent of country on the high ground between the rivers of that province. These woodlands are commonly known under the name of rukhs, and they extend far into the second zone,

which may be termed the dry region of India, and in which the normal rainfall is between 15 and 30 inches.

There are two zones of dry country – one surrounding the arid region on the north and east, in a belt from 100 to 200 miles wide, leaving the foot of the Himalayan range about Umballa, touching the Ganges at Futtehgurh, and including Delhi, Agra, Jhansi, Ajmere, and Deesa. This I propose calling the northern dry zone; its natural forest vegetation is scanty, but better than that of the arid region. In some of the states of Rajpootana there are extensive woodlands carefully preserved, to furnish cover for game, a regular supply of wood and grass, and in times of drought, pasture for the cattle of the vicinity. In the north these woods consist of *Acacia* and *Prosopis*; further south, mainly of a species of *Anogeissus*, a beautiful tree, with small leaves, drooping branches, and dense foliage, which clothes the slopes of the old fort of Chittore and other hills in Meywar, and is the principal tree of the sacred groves of that country. On the Aravalli Hills in Meywar, where cultivation mainly depends on the water stored up in tanks, the value of preserving the scanty thorny scrub on the hills, in order to regulate the filling of the tanks from rain, is recognised by some of the larger landholders. Nor must we forget that we owe the maintenance of the forests in Sindh and of the rukhs in the Punjab entirely to the action taken by the former rulers; and that during the first period after the occupation of the country, the action of the British Government has not in all cases been favourable to the preservation of the forests and woodlands in the arid and dry regions of India. Great exertions have, however, been made of late years to make up in some measure for past neglect in this respect, and in the Punjab extensive plantations have been established since 1865, which now cover upwards of 12,000 acres, the main object in the formation of these new forests being to provide

fuel for the consumption of the railways, and fuel and timber for the large towns in that province. The first commencement of these plantations was made by Dr. J. L. Stewart, the author of several valuable books and papers on the vegetation of North-Western India. There is a second dry region in the Peninsula, comprising part of the Deccan, the Maidan or open country of Mysore, and several districts of the Madras Presidency. Exceptionally moist places are within its limits, such as Bangalore, which, being situated 3000 feet above the sea, has 35 inches rain; but upon the whole, and excluding such hills as rise considerably above the table-land of South India, this belt, which stretches from Nassick in the north to Cape Comorin in the south, has a normal rainfall of less than 30 inches. This belt includes Poona, Bellary, and Kurnool in the north, and Madura and Tinnevelly in the south. Over a great part of it is found the sandal-wood (*Santalum album*), a small tree with fragrant heart-wood, which comes up here and there in bushes and hedges, but does not grow gregariously, and does not form pure forests. Large quantities of this delightfully fragrant wood are used for carving and inlaid work, as incense in Hindoo temples, and there is a considerable export of it to China.

Outside these two dry zones the normal annual rainfall exceeds 30 inches, save north of the first great snowy range of the Himalaya, where rain and snow are scanty, and the country consequently arid and bare. The rest of India has a rainfall greater than that of Europe. Yet really thriving forests are only found where the fall exceeds 40 inches, and rich luxuriant vegetation is limited to those belts which have a much higher rainfall. It must be borne in mind that the annual mean temperature of Central Europe ranges between 45° to 60° while that of India is as high as 75° to 85° . Under a higher temperature a larger amount of moisture is required to produce rich vegetation. At the same time, in India, the

supply of moisture is unequally distributed over the seasons of the year. In most districts the year divides itself into two unequal parts – a long dry season, and a short rainy season. In most provinces of India the principal rains are summer rains, due to the prevalence during that season of the south-west monsoon, and the most humid regions are those tracts which are fully exposed to the influence of these moist south-westerly winds. In addition to these, there are Christmas or winter rains in Northern India, but they only last a few days, or at the outside a week or two, and are, moreover, extremely uncertain and irregular. On the eastern coast of the peninsula the summer rains are slight, the principal fall coming with north-easterly winds in October and November. But in the greater part of India the dry season lasts from November to May, the rains commencing between May and July, and ending between August and October. In the moister districts the rains commence early and last longer, while in the dry belts there is rain only during two or three months of the year; and in the arid region the rainfall is altogether uncertain.

The temperature during this long dry season is cooler at first and warmer afterwards. The mean temperature of the three months, December, January, and February, generally termed the cool season, ranges between 60° in the Punjab, and 79° in the south of the Peninsula. During these months dew is formed more or less regularly, and contributes much to the maintenance of vegetation, particularly in the dry and arid zones. Radiation is so powerful during this season that frost is not of uncommon occurrence in the plains and lower hills of Northern and a part of Central India. These night frosts have interfered much with the satisfactory progress of the plantations in the Punjab, and as far south as Sukkur on the Indus, in latitude $27^{\circ} 30'$, and the Satpoora range in the Central Provinces, in latitude 23° , frost is a serious difficulty

in arboriculture. As far south as Calcutta, ice can be made on carefully prepared beds covered with straw, shortly before sunrise on a still, clear morning. The mean temperature of the three months which follow, which are generally called the hot season, is 75° in the Punjab, 85° along the coast-line, and 90° in the interior of the Peninsula, and this dry heat, with the hot scorching winds which blow over a great part of India during these months, makes this season extremely trying to forest vegetation.

With the exception of the extensive evergreen forests of the Himalaya, and the limited tracts of evergreen forests in the plains and lower hills of the humid regions, the great mass of forests in India are deciduous, and they are bare and leafless during the hot season. During this time of the year, the sojourn in the Indian forests is not pleasant. No shade, no protection against the fierce rays of the sun, great scarcity of water in many parts, and a tent or hut with a temperature in its coolest part of 105° – these are conditions of existence which are not easily forgotten. Deciduous, however, as applied to trees, is a relative term. The only difference is, that an evergreen tree retains its leaves longer than one which is called deciduous. Thus the spruce and silver-fir retain their needles from seven to eleven years, the Spanish *Pinus pinsapo* and the *Araucaria* retain them even longer, hence the full foliage and the dense shade of these trees. On the other hand, the needles of the Corsican and Austrian fir (*Pinus laricio*) remain three to four years; and the Scotch fir, with lighter foliage, has needles of two or three years only on its branches. The Sal tree (*Shorea robusta*), one of the most important timber trees of India, with strong, hard, heavy wood, which forms extensive forests along the foot of the Himalaya and in the eastern part of Central India, retains its leaves nearly twelve months; the old leaves fall gradually, and the foliage gets thinner and

thinner, until the new flush of leaves breaks out in March or early in April. So that although a Sal forest is hot during that time of the year, and there is not much shade, yet the tree is never completely bare. The Teak tree, on the other hand, which may be called the king of Indian timber trees, on account of its useful, durable, strong, and yet not very heavy wood, sheds its leaves as early as January, and is leafless for four or five months, though this again depends upon the supply of moisture, for in low humid places the tree often continues green throughout February. Fortunately for foresters in the hot dry provinces of India, there are to be found in most dry deciduous forests one or two kinds which break out in leaf sooner than the others, and I have spent many an hour during the heat of the day under the grateful shade of what we call the forester's friend (*Schleichera trijuga*), a tree remarkable for its extremely heavy wood, the cubic foot weighing, when perfectly dry, over 70 lbs., or nearly three times the weight of common deal.

AS. 31

The grass and fallen leaves, in these dry, deciduous forests, dry up rapidly during this season and towards March and April everything is so scorched that it is as inflammable as tinder, so that the smallest spark is sufficient to create a conflagration. These jungle-fires are almost a regular annual institution in the deciduous forests of most provinces. In some instances, they are caused by accident, but in the majority of cases they arise from the temporary clearings made by cutting and burning, and the custom of the herdsmen to burn down the old grass in order to cause the fresh tender shoots to spring up as fodder for their cattle. It is true that these fires clear the ground, and make walking through the forest easier; and, up to the present time, many otherwise observant people in India have been of opinion that these fires are not mischievous, and might in some cases be beneficial. The damage, however, done by them defies

calculation. Millions of seeds and seedlings are destroyed, trees of all ages are injured, and often killed, the bark is scorched and burned, the wood exposed to the air, dry rot sets in, and the tree gets hollow and useless for timber. One of the most remarkable facts in the working of the Indian forests in the plains and lower hills has been the large proportion of hollow and unsound trees. In many forests one-half, in others three-fourths of the mature trees are hollow. To a certain extent this is due to the old age of the timber, felled; but experience elsewhere proves that old age can only account for a small proportion of the hollow and unsound trees. The annual jungle-fires are the principal cause of this mischief. In this respect all deciduous forests in India suffer alike. With regard to reproduction, that is, the growth of seedlings, some trees are better off in this respect than others. Thus the Sal tree ripens its seed about the commencement of the rains, after the jungle-fires have passed through the forest. The young plants thus germinate at once in great abundance. The jungle-fires of the coming season kill a good many, and cause a large proportion of the others to grow hollow; but in the dense mass of seedlings which clothes the ground under the parent trees in a sal forest, the damage done is comparatively small. This, to a certain extent, explains how the sal forests are nearly pure, the stronger tree in the matter of reproduction predominating over all the rest. The Teak, on the other hand, ripens its seed early in the dry season the jungle-fires consume large quantities of it; a smaller proportion of seedlings spring up, and these are either killed or cut down to the root year after year by the fires. Meanwhile, the root stock increases in size every year by the action of the shoots, which come up during the rains, and it lasts often after the lapse of many years, it produces a shoot strong enough to outlive the fires. Thus what appears a seedling plant of teak is in most cases really

a coppice shoot from a thick gnarled root-stock, bearing the scars of successive generations of shoots, which were burned down by the annual fires.

Protection against fires is not an easy task in our European forests. Many square miles of Scotch fir in Eastern Prussia, where this widely spread tree is the prevailing kind, have at various times been burned down, and in the cork oak and *Pinus maritima* forests of Provence the ravages have been terrible, the long summer drought of Eastern Europe and of Southern France having in this respect the same effect as the long dry season in India. But in India the task has been a particularly difficult one. The first step was to convince people that these fires were injurious, and when that was accomplished to isolate the tracts to be protected by clearing broad firepaths round them, and burning down, early in the dry season, all grass and leaves in a broad belt surrounding the forest. The credit of having been the first to take in hand this important work on a large scale is due to Colonel Pearson, in those days in charge of the forests in the Central Provinces, and now holding a most important position in the Forest Department under the Government of India. It is mainly due to his energy and perseverance that fires have been kept out for more than six years from a large forest tract of thirty square miles, called the Bori Forest, producing teak, bamboos, and various useful trees, in the Satpoora range. The effect has been marvellous, and if these exertions are steadily continued, this forest promises to become one of the most valuable in the central parts of India.

From what has been said, it will be understood that in the plains and lower hills of India the annual repose of arborescent vegetation is not caused by the cold of winter, but mainly by the drought of the hot season. Shortly before the rains set in, or with the early showers which precede the monsoon, most trees clothe themselves with fresh green,

and in the arid region, where the periodical summer rains are wanting, the summer floods of the river revive the forest growth on its banks after the long drought of the dry season. In those parts of India which have a heavy monsoon, the temperature is generally somewhat lower during the summer months, June, July, and August, than during the preceding hot season. Thus it is that on the western coast of the peninsula the mean temperature of the hot season is 85° , and that of the three succeeding months, when the sky is overcast with clouds, and the force of the sun's rays is rarely felt, is only between 80° and 82° . On the Burma coast also, in Akyab, Rangoon, and Moulmein, the mean temperature of the monsoon months is somewhat lower than that of the preceding hot season. The relief from the incessant powerful action of the sun's rays, brought about by the storms of the monsoon, and the cloudy and rainy weather which follows, is delightful. It is not the vegetation only which revives; the whole animated nature feels the pleasant change. This relief is denied to the arid region. Here, in the north-west corner of India, the temperature continues to rise higher and higher with the sun, and the result is, that in June, July, and August, the highest mean temperature is found in the arid zone of India. Thus Multan has a mean temperature of 77° during what is termed the hot season in other parts of India, and of 92° during June, July, and August; and at Jacobabad, in Sindh, the mean temperature during these months is as high as 96° . Where, however, sufficient water is supplied by irrigation, these high temperatures stimulate vegetation in a remarkable manner. The station of Jacobabad is a striking example of the effect of water supply in that climate. It was founded in 1844 by General Jacob, in the midst of a barren, treeless desert. A canal was led to it from the Indus, and now the plain is a dense forest of babool and other trees, upwards of sixty feet high, sheltering the houses and gardens

of the inhabitants. A ride of a few miles takes you into the desert which skirts the hills of Beloochistan, a level plain of splendid, fertile, alluvial soil, but hard, naked, and barren, like a threshing floor, without shrub, herb, or grass, except in the vicinity of the canals, where vegetation is rich and luxuriant.

In the Himalayan Hills, vegetation rests in winter as it does in Europe, and in the vast tracts of those mountain ranges the forester finds himself surrounded by forms similar to, and in a few cases identical with, the trees and shrubs of Europe. The climatic conditions are analogous, though not identical. At the higher elevations the year divides itself into the four seasons with which we are familiar in Europe, but the main supply of moisture is in summer, and the summer rains are preceded by a long dry season, which is much warmer than the spring is in Central Europe. In the outer ranges the rains are heavy, but the whole falls in torrents within a few months, and has not therefore, the same effect upon vegetation as the uniformly distributed moisture of our own climate. There are other points of difference in the climate of the higher Himalayan ranges and of Central Europe, and this explains that some of the hardiest Himalayan trees, which grow at an elevation of 12,000 feet, within a few thousand feet of the line of perpetual snow, such as the silver fir (*Pinus webbiana*), refuse to thrive in Great Britain and on the Continent. Even the Deodar (*Cedrus deodara*) and the blue Himalayan pine (*Pinus excelsa*), which are common in parks and gardens in England, do not thrive in many parts of Europe.

There is a great difference in the total rainfall in the outer and inner belts of the Himalayan forests. At Siniلا, and in the vicinity, on the outer ranges, the fall is from 70 to 80 inches, and here the Deodar attains a diameter of 2 feet in from sixty to eighty years. The moist southerly currents

which prevail in summer pass over the hot plains of the arid region without depositing their moisture; but as soon as they are brought into contact with the cooler air of the hills and forced upwards into regions of less atmospheric pressure, condensation begins, and their surplus moisture is deposited in the shape of torrents of rain. Thus, there is on the outer ranges of the north-west Himalaya a narrow belt, not more than thirty miles wide, with a rainfall exceeding 75 inches. Further inland the fall decreases rapidly Kotgurh, for instance, distant 40 miles from Simla, has 38 inches only. Beyond the first snowy range the rains are scanty. Here, at the same elevation as in the vicinity of Simla, the Deodar takes from 150 to 200 years to obtain a diameter of two feet; higher up the valley, at a distance, as the crow flies, from the plains of 120 miles, spontaneous arborescent vegetation ceases entirely, the last being the tree juniper (*Juniperus excelsa*), fine specimens of which may be seen growing in Kew Gardens.

The moist zone, with a normal annual rainfall, exceeding 75 inches, which comprises the outer Himalaya, extends north-west as far as the Dhaola-dhar range, which borders the fertile district of Kangra. Beyond this the fall even on the outer hills is less. Thus, the station of Abbottabad, between the rivers Jhelum and Indus, has only 41 inches. South-eastward the moist zone widens. In Lower Bengal the line which indicates its limit passes through Dacca, reaching the coast west of Chittagong, so that Assam, the Khasia Hills, Silhet and Cachar, Tipperah, and Eastern Bengal, are all included. This, the north-eastern moist region of India, also comprises Arracan and the coast districts of British Burma. The eastern portion of this extensive moist belt has a much heavier rainfall than the north-western portion, and here again it is heaviest on the mountains. Thus, Darjiling, in British Sikkim, at an elevation of about 7000 feet, has 125 inches; and

Cherra, the former Sanatarium on the Khasia Hills, at 4000 feet, has an annual fall of 600 inches, or 50 feet. On the Burma coast also the rain is heavy. Thus Akyab, the chief town of Arracan, has 219; Tavoy, further south, on the Tenasserim coast, has 201 inches; and Rangoon, situated at some distance from the sea in a wide extent of nearly level country, has 85 inches.

On the higher mountain ranges of this extensive moist region forests of pines and other conifers extend from the north-west Himalaya southwards to the mountains of Burma. The Deodar has its eastern limit in Kumaon, but there are other coniferous trees, which extend over the eastern part of the Himalaya range. One of the finest of these is *Pinus khasiana*, which is found as far south as the high mountains between the Salween and Sitang rivers in British Burma. These mountains are the seat of a numerous Karen population, formerly an idle, drunken, and lawless race, which, through the teaching of Christianity, brought to them by American missionaries, have become an industrious, sober, and peaceful people. Some of their villages are in the midst of these splendid pine forests, and I have often, when coming from the teak forests in the hot valleys of the Salween and Sitang, been refreshed by the delightful fragrance and cool shade of the pine trees on these hills. But, as if to remind the botanist that, though in a pleasant, cool mountain climate, he is within the tropics, and only 19° distant from the equator, there is an underwood of the sago palm (*Cycas*) under the pine trees, and most of the Karen villages are surrounded by the gigantic bamboo, which yields the posts, rafters, walls, and floors of their houses. The joints of this bamboo are so large that they are used as water pails and buckets. There is another pine tree in Burma, nearly related to a Japanese species, which grows at a lower elevation in the midst of the dry and hot tropical deciduous forests.

These tropical and subtropical pines, however, are not yet of much practical importance. The production of teak timber is the main object which the forester has in view in those parts of the country. The export of teak timber from Rangoon is of old date; but, under the Burmese rule, the quantity exported never came to any very large amount. When the province of Tenasserim became British in 1826, the Attaran forests, which are situated south of the town of Moulmein, were worked with great energy, and yielded large quantities of excellent timber. The supply from that source, however, soon diminished, and thus the attention of timber traders was directed to the extensive teak-producing forests beyond the British frontier, on the Salween river and its tributaries, and from the time the importation of foreign timber into Moulmein has steadily increased until within the last few years, when the quantity floated down decreased, mainly because the stock of good timber in the vicinity of the river and its tributaries had gradually become less. Soon after the annexation of Pegu in 1853, the forests of that province were placed under a regular system of administration, and in 1858 this system was extended to the forests in the province of Martaban and Tenasserim. The result has been that, without impairing their productiveness, the out-turn of the forests in British territory has gradually been raised from an insignificant figure to a very considerable amount; so that within the last five years they have yielded between one-third and one-half of the total quantity of teak timber brought to the principal sea-ports. The timber trade of the Burma ports is not large as compared with that of Canada, yet it is of considerable importance, the export amounting to about 1,00,000 tons annually, with a value of about £ 700,000. The forests in the king of Burma's territory, in Siam and the Karen country, are much more extensive and rich in fine timber than those in our territory; yet, unless

placed under a regular system of management, they will surely be exhausted before long, and on that account we must, to a great extent, look to the forests within British territory for the maintenance of the supply in future. It is satisfactory that the efforts to protect and improve the forests in British Burma have also financially been remunerative. Within the last four years the gross revenue from these forests has fluctuated between £64,700 and £98,400, and the net annual surplus to the State has been between £31,900 and £56,500.

The teak tree in Burma, as elsewhere, is found in the dry deciduous woods, never forming pure forests, but always growing in company with a large number of bamboos and other trees. Its growth is rapid while young, but slow at a more advanced age. In 1862, I sent a few teak poles, 30 feet long, to the great London Exhibition; they had attained that size in two years, in a moist part of the country, on rich soil, and protected from fire. On the other hand, the results of researches made regarding the age of mature trees have led us to the conclusion that more than 100 years are required on an average for the teak tree to attain a diameter of two feet. The fires clear the ground annually of dry leaves and grass, which would otherwise form vegetable mould, enrich the soil, and keep it moist and loose. The bare ground, exposed to the full force of the sun, dries up rapidly with a hard baked surface, the rains of the monsoon rush down the hills and slopes, and the ashes, the remains of the fires, are washed away, without contributing much to the nourishment of the trees. Thus the fires do not only injure the regeneration of the forest, cause the timber to grow up hollow and unsound, but they also impair the productivity of the soil, and retard the rate of growth of the trees. In Burma the fires are principally caused by the practice of taungya cultivation. The forest, instead of being converted

into permanent fields, is cut down in January; and in March or April, when the large mass of stems, branches, and bamboos, which cover the ground, have become sufficiently dry, it is burned. On the first rainfall, rice, cotton, and vegetables are sown, and yield an abundant harvest, no ploughing and digging, only weeding and reaping being necessary. In some cases a second crop is taken; but after that, and more often after the first crop, the field is abandoned, a fresh piece of forest is selected for burning, and in this manner destruction spreads rapidly over large areas. Some of the finest teak forests in British Burma have been destroyed by these clearings; and, with the steady increase of population under British rule, the injury done by this erratic kind of husbandry has become enormous. This mode of wandering cultivation is practised throughout the wilder parts of India; in Mysore, where it is known under the name of kumri, it was possible, about twenty years ago, to protect the forests by stopping this practice throughout the country. This result was mainly due to the exertions of Dr Cleghorn, for many years Conservator of Forests in the Madras Presidency, and afterwards employed by the government of India in the organisation of forest administration in the provinces of Northern India. In Burma, such a summary course of procedure was not found practicable, and instead of protecting the whole of the forests, all that could be done was to prohibit taungya clearings in a limited extent of the best teak-producing tracts, and in those localities which were set apart for the formation of new teak forests by planting. The selection and demarcation of these tracts, which will eventually be the State forests in that province, has not progressed rapidly, and these reserved forests in Burma do not yet amount to more than about 80,000 acres, 1600 acres of which have been covered with teak plantations.

Besides the dry, deciduous tea-producing tracts there

are in the moister parts of the lower hills of Burma extensive and most luxuriant evergreen forests, composed of a large variety of trees, often 200 feet high and more, and so dense that except on the numerous paths trodden by wild elephants, or on the scanty footpaths which lead from village to village, it is almost impossible to penetrate through them. The forester classifies trees with special reference to the amount of light which they require. The Scotch fir, for instance, demands a great deal of light; its seedlings will not readily spring up and thrive under the shade of its own kind or of other trees. The beech, spruce, and silver fir, on the other hand, can stand a great deal of shade; their seedlings will maintain themselves a long time in the deep shade of the forest, growing very slowly, making very little progress; but when a clearing is made accidentally or intentionally, they will shoot up with great vigour. Where woodlands are managed on a large scale, the peculiarities of each kind of tree are carefully studied, and the treatment of the different classes of forest adapted to them. In India, teak demands a great deal of light. On the other hand, most of the trees which compose the tropical evergreen forest will stand a great amount of shade; and thus it happens that the under-wood of these dense forests does not only consist of shrubs and climbers, but to a great extent of seedlings of the very trees which form the dense shady roof overhead. When one of these old giants falls, the mass of seedlings takes a start, and as they all strive upward to the light they draw each other up to a great height, the weaker plants perishing in the fierce struggle for existence. The trees in these forests cannot, however, either in height or growth, be compared to the Wellingtonia of California or to the Eucalyptus of Australia. The tallest tree which I have seen and measured in India was 250 feet high and 38 feet in girth. This was a species of upas tree (*Antiaris*), in the Thoungeen forests

of British Burma. Such dimensions, however, are never found in the deciduous forests. The tallest teak tree measured by me was 102 feet to the first branch, with perhaps, an additional 50 feet of crown above. Teak trees with clear stems, 60 to 80 feet to the first branch, are not rare in the moist regions of India. I have found them in Burma, in the Dang forests, north of Bombay, and in those glorious but hot forests of North Canara, which are probably the most extensive and richest teak forests remaining in British India. Teak of such size and length is only found in very favourable localities where the young trees had grown up close together on rich dry soil, in dells or sheltered valleys, generally in company with tall bamboos, and where they were thus compelled to draw each other up to that height.

Luxuriant vegetation, under the influence of an abundant supply of moisture, has its drawbacks, however, as well as its advantages. Thick masses of tall grass and weeds spring up in the teak plantations of Burma, smother the young trees, and greatly increase the risk of fire. Worst of all are the climbing plants with which the teak, sal, and other forests in all moist tracts abound. Huge creepers, like gigantic ropes, often as thick as a man's thigh, and thicker, stretch from the ground to the top of the trees: they give off numberless branches, and their foliage completely covers and smothers the crown of the tree of which they have taken possession. When a young tree is attacked by one of these gigantic climbers, the stem remains short, gets crooked and deformed, and makes no progress in growth. In Burma several kinds of epiphytic Ficus attack teak and other trees; the seed germinates in a fork or in a hollow of the trunk, sends down its roots, which eventually enclose the stem as with a network. At last the tree dies, and the Ficus spreads its massive but useless limbs in all directions. In the sal forests of Oudh the creepers were particularly heavy and number-

ous when these tracts came into our hands. Owing to several favourable circumstances, it was possible in that province at once to set apart and demarcate a large area of forest land as State forests, and the work of cutting the creepers was at once taken in hand and completed at a considerable outlay; so that now these forests are almost entirely cleared of large climbers, and the young sal has a chance of growing up straight, and forming valuable timber.

Much smaller in area than the north-eastern moist region is that which extends along the western coast of the Peninsula. It begins north of Bombay, and, guided rather by the character of the vegetation than by meteorological observations, which in those wild tracts we do not possess. I have included in it the northern Dangs, a dense and most feverish forest district at the foot of the Khandeish ghats. The eastern limit of this western moist zone runs nearly parallel with the crest of the ghats, but at a short distance from the ghat line. The moist zone thus includes the edge of the ghats, their western slope, and the hilly country between the ghats and the coast-line. Its width varies from 50 to 100 miles. Surat, with 47 inches of rain, is outside; Bombay, which is included, has a fall of 72 inches only, but Tanna, a few miles inland, has 102. Further down the coast, the rainfall is heavier. Rutnagiri has 115 inches. Vingorla 118, and Cananore 123. But the heaviest fall in this zone is on the crest of the ghats. Here, as on the outer ranges of the Himalaya, and the Khasia Hills, the moist currents of air coming from the west, which strike against the steep face of the ghats, are forced upwards into a cooler and more rarefied air, and the consequence is an extremely heavy downpour during the monsoon. Thus the Sanatarium of Mahableshwur, south of Bombay, 4300 feet above the sea, has a fall of 250 inches; but Panchgunny, at a distance of only 10 miles inland from the crest of the ghats, has 50 inches; and Poona, 30 miles from the ghat line,

has a fall of only 27 inches. This rapid decrease of moisture inland explains that the western limit of the southern dry belt runs within a short distance from the crest of the ghats. At the southern extremity of the Peninsula the rain near the coast diminishes, so that Cape Camorin, with 28 inches, and Palamcotta, with 22 inches fall into the southern dry zone.

Forest vegetation in the western moist region is in places fully as luxuriant as in Burma and Eastern Bengal. There are the same great classes of dry deciduous forest, with the jungle-fires as a regular, annually recurring institution, and the moist evergreen forests, including what are commonly called the Sholas of the Neilgherries, into which the jungle-fires do not enter. The rich variety of trees in both descriptions of forest has been carefully studied by Major Beddome, the present head of the Forest Department in the Madras Presidency, and author of the first forest flora published in India, containing a full account of the trees and shrubs of Southern India. In the forcing climate of Malabar, in the heart of this moist region, is the oldest and as yet most extensive teak plantation in India. Commenced in 1844 by Mr Conolly, then Collector of that district, its present extent is upwards of 2599 acres. A hundred acres on an average were planted annually, so that there is a regular succession of thriving plantations, the oldest being now twenty-eight years old, with tall stems 70 to 80 feet high, a splendid instance of the rapid growth of the teak tree in its youth, under good care and in a favourable climate. The northern half of the western moist zone is in the Presidency of Bombay. In this part of India a regular administration of the public forest-lands was attempted as early as 1846, and the result of the early attention paid to this matter may be seen in a large and steady forest revenue, between 82,000 and 123,000 annually during the last six years, one half of which has been a net addition to the general revenues of the Empire. At the

same time, the forests in several districts of the Presidency have considerably increased in value; they now contain a larger stock of growing timber than at the time that conservancy was commenced, and plantations have not been neglected.

While thus a good deal has been done to increase the growth of useful indigenous trees, the introduction of foreign trees has not been neglected in India. The splendid table-land of the Neilgherries, which is raised 7000 feet above the hot plains, is in places getting rapidly covered with forests of exotic trees. From Australia several kinds of Eucalyptus and Acacia were introduced about twenty-five years ago, and they have made such progress that the station of Ootacamund is now almost surrounded by a forest of these trees. Their rate of growth is wonderfully fast, much faster than that of the indigenous trees. At the same time, young forests of the quinine-yielding Cinchonas are coming up in many places. The management of these Cinchona woods will probably be similar to the treatment of oak coppice in England; for though oak bark has not one twentieth the value of Jesuits' bark, it is the bark in both cases for which these woods are mainly cultivated. There will, however, be that difference, that while oak coppice in Europe, after having been cut over, requires from fourteen to twenty years to yield another crop of bark, Cinchonas appear to grow so rapidly that they may probably be cut over every eighth or tenth year. Fever is the great scourge and calamity of India, for natives as well as for Europeans. Cinchona bark, and more so pure quinine, are the only effective remedies, and, if they were less expensive, millions in India would be benefited by them. The natural forests of the more valuable kinds in South America are approaching exhaustion. Experience has sufficiently proved that some of the most valuable species succeed well on the Neilgherries,

in Ceylon, and on the lower hills of British Sikkim, and that they yield an abundance of quinine. But the localities where the best kinds can be grown in India are limited, and it would be well if as much of the available area as possible were planted with Cinchonas. It has been said that India owes more to the Portuguese than to any other nation in the matter of plants and trees introduced from abroad, and certainly the papaya, guava, custard-apple, cactus, pine-apple and agave, all naturalised more or less directly through their agency, bear testimony, in almost all parts of India, to the skill and activity of the early Portuguese settlers. On the other hand, it is due entirely to British enterprise and energy that the Coffee tree, which was introduced about a hundred years ago by a Mussulman saint from Arabia into South India, and first cultivated on the Bababooden Hills, in Mysore, is now grown in numerous extensive well-managed plantations; that Tea, the existence of which in India was hardly known forty years ago, has become an important, annually-increasing article of export; and, lastly, that the Cinchona tree was successfully introduced from South America, and promises to be one of the greatest blessings to the people of India.

So much will be clear from these remarks, that in the climate of India the luxuriance of arborescent vegetation is a sure index of moisture. A glance at the map might tempt us to go farther, and to say that the limits of distribution of the different species in India seem to depend in a greater degree on moisture than on other climatic conditions. The northern limit of Teak, it is true, seems to be more influenced by the temperature of the cold season than by moisture. Natural Teak forests are not found where the mean temperature of the three cool months is considerably less than 60°, though the tree will stand occasional night frosts, which are not uncommon in some of the valleys of the Satpoora range. But no teak is found on the Aravalli Hills about Ajmere,

though that place has a mean temperature of 65° during the cold season. In this direction it apparently is the want of sufficient moisture which has limited the further extension of the species by natural means. By cultivation, this, as most other trees, has been extended far beyond its natural limits; numerous fairly-growing teak trees are found in gardens in Bengal, the north-west, and even in the Punjab; a teak plantation has been commenced at Sikkim; and it has been proposed to cultivate this valuable tree on a large scale in Assam. Within certain limits the teak tree does adapt itself to different conditions of soil and climate; but limits there are, and, as far as our present knowledge goes, it thrives best with a rainfall above 30 inches, a mean temperature during the three cool months of between 60° and 80°, and during the rest of the year between 70° and 90°. Teak is spread over a great part of the dry belt of Southern India, but only as poor coppice, yielding a scanty crop of poles and rafters, and never attaining any large size.

The Sal tree is found in two large belts, one extending along the foot of the Himalaya range from Assam to the Sutlej river, with a few outlying patches beyond, and the other occupying the eastern part of Central India. The Sal depends, to a much greater extent than the teak, on certain peculiarities of soil; it is mainly found on sandstone, conglomerate, and gravel, but does not thrive on the heavy clay-soil which overlies the extensive trap-rocks of the Deccan and part of Central India, and this peculiarity may have a considerable influence in limiting the area of its distribution. It stands more cold than teak, but it does not seem to thrive with less than 40 inches of rain.

A far more limited range of distribution has the Caoutchouc tree (*Ficus elastica*), a tree which is frequently grown in conservatories and drawing-rooms in this country and on the Continent; so much so, that in Germany it goes

by the name of the Berlin weed. Its milky juice yields a description of India rubber, not equal to the excellent Para rubber, the product of an altogether different kind of tree in Brazil, but which may be capable of improvement by a more careful method of collection. In India this Caoutchouc tree has only been found in the moist forest skirting the Eastern Himalaya from Sikkim to Assam, and at the foot of the Khasia and Cachar Hills. A humid atmosphere, and equable temperature throughout the year, seem to be the principal conditions of its free growth. The mean temperature in the stations nearest to the caoutchouc forests is between 60° and 63° in the cold season, and 80° and 85° in the three hottest months.

The conditions of existence under which the Deodar grows at the north-western end of the Himalayan range are altogether different. To begin with, it demands a certain elevation; as a rule it does not thrive in the north-west Himalaya under 4000 feet, but it ascends to 10,000 and at times to 12,000 feet. As to mean temperature, a range between 35° and 30° in the cold season, and 65° to 75° during the three summer months, seems to suit it best. As regards humidity, the Indian cedar does not go beyond certain limits of drought and moisture. In the Sutlej and other Himalayan valleys it disappears where the arid region commences, although the conditions of soil, temperature, and elevation are not unfavourable. Again, it is wanting in the Eastern Himalaya, where the rainfall exceeds 100 inches. The Deodar is so closely allied to the Cedars of Lebanon, the Taurus, and the Atlas mountains, that botanists find it difficult to keep them distinct as species. As close comparison of the climatic conditions under which these western cedars grow, with the climate of the north-west Himalaya, may lead to interesting results regarding the history of the spread of these beautiful and useful trees. It is not, however,

climate, soil, and the action of man in historic times alone, which determine the area over which plants or trees are actually found at the present time; other far more remote causes have been at work, the study of which forms the most interesting part of botanical geography. The forester, however, has to take things as they are, and to him the most important point is to ascertain the conditions most favourable for a vigorous growth of those trees which pay best, and which yield the largest quantity of timber and other forest produce within a certain time on a given area.

The other trees indicated on the map, Babool and Sandal-wood, are satisfied with a moderate supply of moisture. The Babool tree is spread over a great part of India, but it is wanting or does not grow well in the moist zones. Without irrigation it seems to grow best under a rainfall between 15 and 60 inches; and where moisture is supplied from below, it thrives well in the driest parts of India. The Sandal-wood is at home in India mainly in the southern dry zone; it demands a hot dry climate. In gardens it is grown in many of the more humid districts, but the heart-wood is less fragrant and less valuable. The tree is not, however, limited to India; it is also found in the Indian Archipelago, and there are other species of the same genus yielding Sandal-wood in the Fiji and other islands of the Pacific, from whence it is largely exported to China.

What has here been advanced makes it sufficiently clear that there exists an intimate connection between the climate of India and its forest vegetation. The practical aspect of the subject, however, has not yet been touched upon. Well may the question be asked, why we should trouble ourselves concerning the maintenance and improvement of the forests in a country which has a civilisation many centuries older than our own, which has existed and has maintained an immense population so long, without feeling the want of

any systematic care of its forest lands? I must ask the reader at once to dismiss the idea that by preserving and improving the forests of India we may hope materially to change and improve its climate. It is a widely spread notion, entertained by many writers who are competent to judge, that forests increase the rainfall, and that the denudation of a country in a warm climate diminishes its moisture. Much of what is known regarding the history and the present state of the countries round the Mediterranean seems to support this theory, but it has not yet been established by conclusive evidence. In India, where, directly or indirectly, the success or failure of the crops depends on rain at the right time and in suitable quantity, it is natural that the conservancy and improvement of its forests should have been regarded as one of the means to be employed for a better regulation of the rainfall. Many remarkable facts are recorded, which seem to show that in comparatively recent times, the denudation of certain tracts has been accompanied by changes in husbandry, indicating a diminished or less regular rainfall. There is not yet, however, sufficient evidence to prove that a material deterioration of the climate has been the result of denudation in any part of India. Much less has it been established that by preserving and extending the forests we may hope considerably to increase the rainfall. Not that a country covered with forests is not under certain circumstances likely to have more frequent and heavier showers than a hot barren desert, but there is no prospect of our carrying out in India any measures on a sufficiently large scale to effect any appreciable improvement of the climate. In the moist zones, and in a large portion of the intermediate region, the country would not benefit if the total annual rainfall was increased. The land would undoubtedly produce more frequent and heavier crops if we could by any means more equally distribute the moisture over all seasons of the

year. The seasons in India, however, are regulated by the dry north-easterly winds which prevail during one-half of the year, and the wet south-westerly currents which reign during the other half; and these, again are the results of the rotation of our globe, the position of the sun, and the distribution of land and water on our hemisphere, and of other cosmic phenomena which will not be affected by any forest cultivation in India. What might be extremely useful would be to increase the rainfall in the arid and dry regions, where the cultivation of the land to a great extent depends on irrigation, and where a dry season causes famine of the most terrible character. If by any means we could increase the atmospheric moisture in the drier districts of the Deccan, in parts of Mysore, Rajpootana, Sindh, and the Southern Punjab, these countries might maintain a dense population in prosperity. But of such improvements all prospect is denied to us. If it were possible to cover any large proportion of these dry districts with forests, the stratum of air overlying the top of these forests would undoubtedly be cooler and moister, and during the south-west monsoon this would certainly bring down a few additional showers. But it is not possible. Save along the banks of rivers, there is no moisture to raise and to maintain such forests, which I fear will remain a fond hope not to be realised in our time. By preserving and improving the woods along the coast of the western ghats, it has been stated that the rainfall in the dry country beyond might be increased. As far as our knowledge reaches at present, it seems probable that heavy forests along the edge of the ghats, and in their vicinity, have the effect of increasing the local fall of rain along this belt; but if this is the case, the westerly winds will be drained of their moisture, even to a greater extent than if there were fewer forests, and there might possibly be less condensation and less rainfall in the dry country beyond.

Nevertheless, there is no doubt that every grove and every group of trees in the dry and arid regions of India is a blessing, the value of which cannot be estimated too highly; and though we may not be able to raise extensive forests in these districts without irrigation, yet a great deal can be done by improving and extending the wooded tracts along the borders of the dry country. Save in the most arid districts, mere protection from cattle, cutting, and fires is sufficient to produce, not, it is true, dense forests, but brushwood and grass, which certainly, in a small way, serve to keep the ground cooler and moister. There is no country in India where the beneficial effects of mere preservation of brushwood tracts in a dry climate may be better studied than in some of the native states of Rajpootana. Such chiefs as the Rajah of Kishengurh, the Thakoors of Bednore and of Humeergurh, and their ancestors, have set a good example, which the forest officers of the British Government will do well to imitate.

Whatever views may be held regarding such slow, gradual, and limited effects of forest growth upon the climate, there is no doubt that, in a hilly country, forests enable us in many cases better to husband the existing water supply for irrigation. Whether the drainage from the hills is collected in tanks and artificial lakes, as is the case in Rajpootana and Mysore, or whether it is employed to feed canals, to carry water, fertility, and wealth into distant districts, the object is the same – to utilise to the utmost the water supply available during the year. Experience in India and elsewhere has proved that where hills are bare, the rain rushes down in torrents, carrying away loose soil, sand, and stones, silting up rivers and canals, breaching or overflowing dams and embankments; but that where the hills are covered with meadows, fields, or forest, the superficial drainage is gradual, the dry weather discharge of rivers regular, the

springs better supplied; in short, all conditions united to ensure the more regular and useful filling of tanks and canals; and in many cases the attainment of these objects is in itself of sufficient importance to justify measures for the preservation and improvement of natural woodlands, and for guarding against the denudation of hilly tracts. The preservation of forests may be made necessary by other objects of a cognate nature; for instance, in order to protect roads and bridges in hilly tracts, to guard against landslips, to prevent the formation of ravines, the silting-up of rivers, and other mischief which may follow the denudation of hilly tracts.

Nor is it at all impossible, that in some cases the preservation and extension of arborescent vegetation may have a beneficial effect upon the sanitary condition of a district. The late unhealthiness of Mauritius has generally been ascribed to the gradual denudation of the island; and public feeling there has been so strong upon the subject that legislative measures have been proposed to facilitate the re-foresting of the waste lands. Too much importance must not, however, be attached to the value of forests in India from a sanitary point of view. The district of Rutnagiri, which is situated south of Bombay, between the coast and the ghats, has been densely inhabited for centuries; and in consequence mainly of the practice prevailing in the Concan, of manuring the fields with ashes of leaves and branches, the whole district has gradually been denuded of trees, save groups of pollards, which are annually lopped for manure, groves of palms, and fruit trees in gardens. Yet this district is proverbially healthy; more so than the adjoining British districts, Tanna and Colaba in the north, and Canara in the south; nor is there any proof that the rainfall of the Rutnagiri district is less than it ought to be with regard to its position on the coast. Nevertheless, even here denu-

dation has done serious mischief. Several of the short tidal streams of this part of the Concan, which were navigable in former times, have gradually silted up, and are now useless, except for very small craft.

Beyond all doubt, however, forest conservancy in India has become necessary in order to meet the growing demands for timber, wood, and other forest produce. Under the influence of peace and security, which all parts of the country are enjoying under British rule, prosperity is increasing rapidly in most provinces. The peasantry of entire districts, who have hitherto been content to live in miserable huts, desire to build good substantial houses and to use better furniture. Hence an increased demand for bamboos, wood, and timber. In certain forest tracts the watershed of the timber trade has entirely changed since the American war has stimulated the export and cultivation of cotton. From the forests of north Canara, the former export of timber was all seawards, and fortunately it was not of great importance, and has not exhausted the forests. The export inland was trifling. Since the American war, however, a considerable demand of timber and bamboos for the cotton producing tracts east of Dharwar has sprung up, and brisk trade is now carried on in that direction. Similar changes in the lines of export have taken place in the Kandeish Dangs, and elsewhere in many places. The rapid construction, within the last twenty years, of railways, canals, and public buildings of all descriptions, has created large demands for timber and wood. Although a considerable proportion of the railway sleepers laid on the Indian lines were brought from Europe, the demand in India for this item alone has been so heavy, that within the last fifteen years extensive forest tracts have been denuded of nearly all their standing marketable timber, to furnish railway sleepers. In every respect, therefore, the drain upon the resources of our Indian forests is heavier now

than it was formerly, and is likely to remain so; and unless the small extent of remaining valuable forest is carefully managed, with a view to its regeneration, there will certainly be difficulties hereafter. For the law that an increased demand will always produce an increased supply does not hold good when the supply requires one hundred years to become available.

It is not, however, timber only the permanent supply of which we must endeavour to secure for the benefit of coming generations. There seems no prospect of finding coal in sufficient quantity in North-Western India. Railways and steamers in the Punjab and Sindh burn wood, and will probably continue to do so. At the same time, the demand for fuel in the towns and villages of Northern India will increase. Hence the necessity of extensive plantations, and of careful management both of the scanty woods on dry ground, and of the more productive forests along the banks of the rivers. These are the future requirements of India in this respect, and they must always hold the first place in the consideration of public measures of this nature. For, after all, if it were not for the benefit of the people of India, there would be no reasonable ground for undertaking the arduous task of preserving and improving its forests. On the other hand, the interests of trade may justly claim to be heard in this matter. Sandal-wood, cutch (the produce of *Acacia catechu*), caoutchouc, lac, teak timber, and numerous other kinds of forest produce, are important articles of export from India, and the maintenance of a sufficient supply to satisfy the requirements of trade is a matter of great moment. Nor does the export of these articles benefit the merchant only; it adds largely to the prosperity of the people of India.

These are the principal reasons why forest conservancy in India is necessary. A more difficult question is, how the objects we have in view are to be attained. Forests, like all

other landed property, can be either in the hands of the State, of towns, village-communities, or other public bodies or corporations; or, lastly, in the hands of private individuals. There are thus two ways of accomplishing our object. Either the State must, by legislation, subject all forest property to a certain control for the public benefit, reserving to itself the right of compelling the proprietor to manage it in accordance with certain rules and prescriptions laid down from time to time, as circumstances may require. In many European countries this plan has been more or less successfully pursued, and in most is still maintained with regard to forest land which is the property of municipalities, villages, and public corporations. In France, for instance, the management of all these classes of forests is under the control of the State Forest Department; and, upon the whole, the system works well. Similar arrangements exist in Prussia and in other German countries. Private forest property, however, is practically free in most European countries. Nearly all European States hold large forest domains in the hands of Government, and this makes it possible to maintain an efficient body of public forest officers, with practical experience competent to manage or to control the forests of other proprietors.

Italy has, it is true, of late years pursued a different policy, but its success is doubtful. The greater portion of the State forests and of the ecclesiastical estates, which might have been formed into State forests, have been sold; and the project of a law, placing such tracts of private and other woodlands, as may from time to time appear necessary, under the control of the State forest officers, has repeatedly been discussed, but as yet without any practical result.

In India, everything tends to show that the State must endeavour to retain as many of the more important forest tracts as possible in its own hands. In first instance, this seems the only way of forming an efficient body of forest

officers with practical experience. In the second instance, the control of forests in the hands of other proprietors will, in India, always be a peculiarly difficult matter. Not that the formation of village forests, and their regular management under the control of State forest officers, would not be a most desirable object to aim at. Certainly, the advantages of well-managed communal forests are great. The public property thus created cannot readily be converted into cash, and wasted by an improvident generation. It yields a fixed and certain annual revenue, available for roads and other public improvements. In many parts of continental Europe, long experience has shown that well-managed communal forests increase the prosperity of communities and their inhabitants, facilitating at the same time the development of healthy municipal institutions. And though at present it would be premature to expect the people of India to appreciate the advantages of such institutions, the time will certainly come when the importance of proposals tending in this direction will be recognised. But so much seems certain, that the State ought not to undertake the control of forests of other proprietors until its own forest officers have the needful practical experience, and are competent to manage them to the best advantage.

The general principle, that the more valuable forests should as far as practicable be formed into State forest domains, has, after much opposition, gradually been acknowledged in most provinces of India; and in some provinces the process of demarcating these State forests has made considerable progress. From a late return, I gather that the area of the reserved forests in the provinces under the government of India, outside those of the Madras and Bombay Presidencies, but including the forests leased from native princes, is estimated at 9800 square miles, or 6,200,000 acres. In India, these forests are called "reserved forests," as

they are formally reserved from sale, except by the express permission of the Supreme Government. By way of comparison, I may mention that the Crown forests of England cover 112,000 acres, the State forests of France upwards of 2,500,000 and the State forests of the kingdom of Prussia upwards of 6,000,000.

The area here given for India, however, includes a large extent of forests which are not the property of the State, but which are only leased for a definite time from native chiefs and princes. It also includes a large extent of woodlands, which have not yet been finally demarcated, or in which, though the State may be the proprietor, the surrounding agricultural population exercise rights of pasture, of cutting wood and timber, and, in some cases of clearing ground for cultivation. In a few provinces, such as Sindh and the Central Provinces, circumstances were favourable at the time of demarcation, and the State acquired at once absolute proprietorship of these forest lands free of all prescriptive rights. In other provinces, the gradual adjustment and extinction of these rights, which materially interfere with the protection and systematic management of the forests, will be a work of time, which will require much care, patience, and conciliatory treatment of the people concerned. In this, as in other matters relating to the administration of forests in India, we are guided by the experience gained in this country, and on the Continent of Europe, in dealing with rights of commons and other prescriptive rights in forest land. There has been much thoughtless talk as if the natives of India, in burning the forests and destroying them by their erratic clearings, were committing some grave offence. If the matter is carefully analysed they will be found to have the same sort of prescription which justifies the commoner in the New Forest to exercise his right of pasture, mast, and turbary. Such rights, when the public benefit requires it, must be

extinguished; but the wild tribes of India have the same claim as the holder of prescriptive forest rights in Europe to demand that provision be made for their reasonable wants and requirements. The State forest domains in India are thus in course of formation only; the greater mass of them is in a poor and exhausted state; many are burdened with heavy rights of pasture and other prescriptive demands. For many years to come they must be worked most sparingly; considerable sums must be expended on the demarcation and survey of boundaries, on roads, the clearing of streams, on plantations, and other improvements. At the same time, all these operations and the protection of these extensive tracts require large and expensive establishments. These are the reasons why the administration of the public forests in India has not yet within the short period of its existence yielded any large surplus revenue to the State. The gross income of the Government forests in British territory has within the last three years fluctuated between £420,000 and £465,000; but the charges have been high, and the highest net surplus of the year has amounted to £160,000 only, and in another year fell as low as £86,000.

Nevertheless, there is no doubt that, financially also, the formation of State forests in India, and their methodical management, will eventually be an important source of revenue and strength to the Government. In this, as in all matters, the first commencement has been difficult. The idea of providing for coming generations may to many appear an unnecessary waste of time; but when the present generation begins to derive substantial benefits from these measures, then their value will doubtless be fully recognised.

Chapter-2

PROGRESS OF FORESTRY IN INDIA

The long period of peace, of good and just government, which followed the consolidation of the British Indian Empire, the construction of railways and other public works, and the rapid increase of trade and prosperity, have contributed much to accelerate the destruction, of forests in India. Over large districts and entire provinces the forests have been cleared to make way for the plough and the increasing population, and where forests were left, most of the accessible timber was cut and brought away to be used as fuel and charcoal, for shipbuilding, for railway sleepers, for bridges and other buildings.

Hence it came to pass that forests, which in old days were regarded as a thing to be got rid of and as an obstacle to civilisation, attracted attention, and that the necessity of preserving them began to be considered. As early as 1844, Mr Conolly, then Collector of Malabar, commenced planting Teak on a large scale at Nilambur, in his district, in order to provide timber when the forests, which were rapidly disappearing, should be exhausted. In 1839 and 1840 the Government of the Bombay Presidency issued orders to stop the cutting of Teak wood on Government land, and in 1847 Dr Gibson was appointed Conservator of Forests in Bombay. In the same year Mr Colvin, Commissioner of the Tenasserim provinces, commenced organising a Forest Department at Moulmein; and in 1856 Dr Cleghorn was appointed the first Conservator of Forests in the Madras Presidency. Five years later, in 1861, Dr Cleghorn was deputed to the Punjab to examine the forests in the Western Himalaya, and in 1866 he was selected to officiate as Inspector-General of Forests.

The system which has now been accepted in the two

Presidencies of Madras and Bombay and generally throughout India consists in this, that from among the vast area of forest and waste which is at the disposal of the State, certain lands are selected and demarcated, which are called Reserved Forests. They might have been called State forests in accordance with the practice which obtains in those countries of Europe where the development of forest management has been analogous to what has taken place in India. The Reserved Forests in India are State forests in the sense in which this term is used in France, Germany, Austria, Denmark, and other countries of Europe; but they are not the only forest lands at the disposal of the State, and hence they are for the present called Reserved Forests.

The administration of forests generally, and in particular the constitution of these Reserved Forests and the procedure by which they are gradually freed from customary rights, which villagers and private persons have been in the habit of exercising in them, are now regulated by legislative enactments. The Indian Forest Act was passed in 1878, the Burma Forest Act in 1881, and the Madras Forest Act in 1882. Other local enactments are in force in several districts and provinces where peculiar circumstances required special legislation. In the review of forest administration for the year ending March 1882, written by Dr Schlich, Inspector-General of Forests to the Government of India, the total area of Reserved Forests on that date is stated as follows:

In the provinces under the	
Government of India,	35,242 square miles
Less Seccond-class Reserves	
in the Central Provinces	16,842 square miles
	18,400 square miles
In the Madras Presidency	1,182 square miles
In the Bombay Presidency	9,789 square miles
Total	29,371 square miles.

A word should be said regarding the second-class reserves in the Central Provinces. Legally they are reserved forests like those of the first class; no fresh customary rights can accrue in them, and no land can be alienated without the sanction of Government. But they have not been protected strictly, as the first-class reserves have been, their boundaries are not clearly marked on the ground, and they are cut up by cultivation, which has frequently been permitted in them without fixing the limits within which it may be carried on. Eventually a portion of these second-class reserves will probably be given up for cultivation, while the remainder will be strictly protected and added to the first-class reserves. In the Central Provinces, as elsewhere, the policy followed has been, in the first instance, to concentrate operations upon limited area; but now, since an efficient staff of forest officers has gradually been organised, it has been found possible to expand operations and to take in hand larger areas. In the area shown as Reserved Forests are included 402 square miles of forests leased from Native States, chiefly in the North-West Himalaya. In all provinces large additions to the reserved area are steadily made, chiefly in the Presidency of Madras, where the work of forming Reserved Forests has hitherto been backward.

The extent of country under British administration in India, not including Native States, may be put down at 870,000 square miles, of which about 246,400 square miles, or 28 per cent, is cultivated, while the rest, or 623,600 square miles, is forest, waste and pasture land; much of this, however, is private property, and the total area of forest land at the disposal of the State is not in all provinces accurately known. The Reserves it is intended to maintain permanently as forest, and the remaining lands at the disposal of Government will be available either for the further extension of the State forests when such may be found necessary, for the

formation of village forests to be managed by the village communities for their own benefit, for pasture lands, or for the extension of cultivation.

The trees of which the Indian forests consist are entirely different from those common in Europe. The variety of trees is much greater; in Great Britain there are only about 40 species of indigenous trees, while in India they number over 2000. Only in the temperate climate of the North-Western Himalaya is the general character of the forests similar to that in Europe, and there are even a few kinds which are common to both countries, such as the yew and the boxwood. Here are found forests of oaks and coniferous trees, with an admixture of maples, elms, hornbeam, birch, and poplars; the banks of streams are lined by tall alders the shrubs and underwood consist of willows, barberries, roses, and brambles. The genera are often the same, but the species are almost all different, and with them are associated many kinds which have nothing in common with the trees and shrubs of Europe. In these forests the most important tree is the Deodar (*Cedrus deodara*), which forms extensive forests at an elevation of between 6000 and 9500 ft.; these forests are rarely pure, but the Deodar is largely mixed with other less valuable trees, partly conifers, partly oaks, and others. The value of this noble tree, which under favourable conditions attains a height of over 200 ft., consists in the great durability of its timber. In the climate of India most woods are apt to decay and to be destroyed by insects a few years after having been cut. Deodar is one of the few durable woods in India, and beams of it have been known to last several hundred years.

A large belt of forest stretches at the foot of the Himalaya from the Punjab to Assam, and the two most valuable trees in this forest belt are Sal (*Shorea robusta*) and Sissoo (*Dalbergia sissoo*). As in the case of Deodar, their value

consists mainly in the durability of their timber. Sal belongs to the natural order of Dipterocarpeae, which has no representative in Europe, and is remarkable from the long wings on the tops of the large round seed. This tree is eminently gregarious, and on the stretches of high land between the rivers which issue from the hills, it forms extensive forests, almost pure, the ground under the old trees being generally covered with a dense mass of seedlings. The Sissoo tree, which belongs to the natural order of the Furze, the Robinia, and the Laburnum, forms forests, partly by itself, partly associated with the Cutch tree (*Acacia catechu*) and other kinds, near the rivers and on the deposits of sand and shingle which extend along their banks. Sissoo extends far up the valleys into the hills to an elevation of 3000 ft. The timber, which takes a fine polish, has not the great hardness of Sal and works better; it is used largely for furniture and carriage-building. Extensive plantations of Sissoo have been formed, chiefly in the Punjab, and the establishment of a good system of rearing Sissoo on a large scale, and at a moderate cost, is due mainly to Mr B. Ribbentrop, the Conservator of Forests in that province. *Acacia catechu* is not, like Sissoo, limited to the sub-Himalayan forests, but is also found in Burma and other parts of tropical India; its dark red heartwood is extremely durable, and is prized for pestles of oil mills, for rafters and house posts. But the most valuable product of the tree is Cutch or Catechu, an excellent tanning material, which is extracted by simmering chips of the heartwood in water, and boiling down the red fluid into a hard shining black mass – the Catechu of commerce.

In the moist climate of Assam, where the Sal tree attains its eastern limit, the India-rubber tree (*Ficus elastica*) is found in the dense evergreen forests at the foot and in the valleys of the Himalaya and of the Naga Hills, which bound the Assam valley on the south. This is a huge evergreen tree of

the tig tribe, with thick leathery shining leaves, which sends numerous aerial roots down to the ground from its branches. The white milk which oxudes from cuts made in the stem and roots is collected and dried, and forms the caoutchouc which is exported from Calcutta. The tree is found chiefly outside British territory in the hills which surround the Assam valley and which extend from the head of that valley north towards Arrakan, as well as in Native Burma, north of Bhamo. The export of this article from India in 1881-82 amounted to 10,680 cwts., valued at £108,843; but owing to the reckless treatment of the trees in tapping, this supply, which mainly comes from beyond the frontier, must eventually diminish, and hence it became necessary to establish plantations. In Assam 1000 acres are now stocked with *Ficus elastica*, some of the trees being nearly ten years old, and those in the older portions being from 30 to 40 ft. high. The success of these important operations is chiefly due to the skill and perseverance of Mr Gustav Mann, the Conservator of Forests in Assam. The caoutchouc plantations are being steadily extended.

Sandal wood (*Santalum album*) is a small evergreen tree, with elegant hanging branches and black berries, the heartwood of which is valuable on account of its strong scent. It is used as incense and for carving, and is largely exported, chiefly to China. The native State of Mysore in South India is its chief habitat, but it is also found in the adjoining districts of the Madras Presidency, in Coorg, and in North Canara.

Of all Indian forest trees the most important is the Teak (*Tectona grandis*), a deciduous tree of the natural order of Verbenaceae, to which *Vitex* and *Verbena* belong, with large rough leaves, often 3 ft. long. This tree is found associated with Bamboos and a great variety of other trees, most of which have \rightarrow , or very little, market value. Pure natural teak

forests are rare, but they are sometimes found on dry and poor soil. In the island of Java teak is described as a more gregarious tree than it is in India; but the home of teak is in the moister regions of tropical India, and the most extensive teak-producing forests are in the Transgangetic Peninsula, in Burma, and Siam. In Central India and on the Irrawadi river it extends to north latitude 26°.

It may justly be said that teak is among woods what gold is among metals – it is not only exceedingly durable, but it works well, takes a fine polish, does not split or warp, and is neither very hard nor very heavy. The only timber, which might in some respects take a higher rank, is mahogany. Indian teak is more prized than any other timber, and it forms an important article of export from Burma to Europe and America; but the only ports where teak is now shipped in large quantities are Rangoon and Moulmein in Burma, and Bangkok in Siam. Its price is exceedingly high at the present time – as much as £15 to £16 the load of 50 cubic ft. in the London market.

The following figures, which show the imports from all sources, foreign and British, into the ports of Rangoon and Moulmein, as well as the exports from these ports, all in loads or tons of 50 cubic ft. will give some idea of the great increase in the consumption of this timber since 1856. The figures are annual means for periods of eight, five, and three years:

Periods.	Imports.	Exports.
8 Years, 1856-57 to 1863-64	85,000 tons	77,000 tons.
5 Years, 1864-65 to 1868-69,	113,000 tons	108,000 tons
5 Years, 1869-70 to 1873-74,	133,000 tons	98,000 tons
5 Years, 1874-75 to 1878-79,	227,000 tons	135,000 tons
3 Years, 1879-80 to 1880-81,	169,000 tons	135,000 tons.

During the 1st three years the mean annual yield of the Government forests in British Burma was 24,000 tons, and the imports from beyond the frontier amounted to 145,000 tons. But the forests beyond the frontier are worked without any regard to their maintenance, and it is impossible that they can much longer continue to yield the same quantities as hitherto. On the other hand the yield of the Government forests may be expected to increase considerably, and the aim is to increase the proportion of teak in these forests by protection and planting to such an extent as to enable them to yield annually and permanently a quantity equivalent to the timber at present imported into Rangoon and Moulmein. There are not many places where teak is found outside India and the Transgangetic Peninsula; but the Burma ports and Bankok have not altogether the monopoly of this valuable timber. The teak forests of Java are reported to have an area of 2280 square miles; they are under regular management by a Government Forest Department, and during the fifteen years from 1865 to 1880, 24,700 acres have been planted up. The natural teak (Djati) forests of that island, of which a graphic description is given in Junghuhn's excellent work on Java, are situated in the eastern or drier portion of the island, and, like the Indian teak forests, they were formerly overrun by the annual forest fires of the dry season. The stature of the trees in the Java forests is described as small, only 50 to 60 ft. on an average; while in Burma and near the Western Ghats the teak attains 100 ft. and often more. Protection against fire will probably have the same beneficial effect in Java as in India, and the forests of that island may eventually be expected to contribute their share to the teak required by the world's trade.

There is a class of plants which gives a peculiar character to most Indian forests, and this is the bamboos. They are tall arborescent grasses, generally growing in dense clumps,

consisting of numerous slender stems, often 60 ft. high and more. The stems are hollow, light, and very strong, and they furnish most valuable material for building; but they are also used to make baskets and mats, and the walls, floors, and even the roofs of houses are often made of stout bamboo matting. The demand for bamboos is very large, many millions being annually floated down from the Burma forests, and they are exported from most of the larger forest districts in India. Only in some remote districts are the bamboos as yet without value. A project was started a few years ago to use the fresh shoots of the bamboo for the manufacture of paper, and extensive concessions were made by Government to the promoters of this project. Excellent paper from bamboo is made in China, and there seems no doubt that fresh bamboo shoots yield one of the most valuable of paper stuffs. But in most districts the stems fetch much more when mature than the papermaker could afford to pay for the fresh shoots, and in those remote districts where bamboos have as yet no value, the unhealthiness of the forests, the scarcity of labour, and other difficulties are in the way of this undertaking.

Besides the trees indigenous to India, much has been done to introduce trees from other countries, and in some instances they have succeeded remarkably well.

Of the trees of Northern Europe or of North America, none have been raised on a large scale, the climate being totally different. The Olive, the Sweet Chestnut, the Carob (*Ceratonia siliqua*), and some other trees of South Europe, have been introduced into Northern India, and of these the Sweet Chestnut promises to thrive well in some portions of the North-West Himalaya. The Mahogany tree was brought from the West Indies about ninety years ago, and there are a number of large trees in gardens near Calcutta, which produce timber equal to that of the American tree. Great

exertions have been made to grow this tree on a large scale in forests, but the success has, with few exceptions, been indifferent; in Pegu, however, there seems some prospect of the Mahogany succeeding as a forest tree. An introduction from tropical America, the Rain tree (*Pithecellobium saman*), whose timber has no value, but which is remarkable on account of its extremely rapid growth, has succeeded wonderfully well in most of the moister districts of tropical India. Attempts have been made with great preseverance, and at considerable expense, to introduce several of the tropical American trees which yield Caoutchouc, and one of these, the Ceara rubber (*Manihot glaziovii*), has been found to grow freely in the moister districts of tropical India.

The paper Mulberry of Japan (*Broussonetia papyrifera*), which yields also the tapa cloth of the South Sea islands, is now cultivated in Assam and Burma, and promises to be an important introduction. In Japan, this tree is grown as coppice, in the same way as osier beds in England; and, if the experiments continue successful, its fibre may become a valuable forest product in India.

The most remarkable instance of a foreign tree is the Australian Blue Gum (*Eucalyptus globulus*) on the Nilgiris. Of this, as well as of two species of Acacia, viz., *A. dealbata* the Wattle, and *A. melanoxylon* the Blackwood, forests have been raised, and around the stations on the hills these trees are now so numerous that they give a peculiar character to the landscape. The Blue Gum was first introduced in 1843, and there are trees at Ootacamund now thirty years old, over 13 ft. in girth, and over 110 ft. high. When young the tree shoots up with great rapidity, and under favourable circumstances trees ten years old are 80 ft. high, with a girth of from 2 to 3 ft. After that age the growth in height is less – only about 2 ft. a year, but they add greatly to their girth. 1230 acres on the Nilgiris, on that portion of the plateau

which is occupied by native villages and by European planters, have been planted by Government with the Blue Gum and Acacia. The indigenous woods have here been largely cleared; those which remain are not very extensive, and the indigenous trees have an exceedingly slow rate of growth, so that the introduction of these fast-growing Australian trees has been most useful for the supply of timber and fuel. In order to ascertain exactly the rate of wood production per acre, valuation surveys were made in the summer of 1882 by Mr D.E. Hutchins, then Assistant Conservator of Forests in Mysore, with the result, that in the plantations ten years old the stock standing on one acre measured 6800, and in a plantation nineteen years old, 9000 cubic ft. of solid wood. The mean annual production of wood in these Blue Gum plantations, therefore, has up to date been at the rate of about ten tons, or 500 cubic ft. of solid wood, per acre, which is more than five times the quantity produced by high timber forests in Europe. The Acacias grow less rapidly, and they produce only about half the mean annual quantity per acre, but still they do much better than any of the indigenous woods.

The successful introduction of the Larch and the Austrian and Corsican Pines into Great Britain, and of many North American trees into Europe, justify the expectation that forests of a few foreign species may be raised in India; but even these brief remarks will serve to show that in India trees may succeed well in gardens, and yet not answer when grown on a large scale in forests.

Forest management in India has commenced to yield a steady and growing annual revenue to the State. This revenue might be much larger if the forests were not managed with the chief object of improving their condition; hitherto cuttings have been restricted, and attention has been chiefly devoted to the formation and improvement of these

Government domains. In the provinces immediately under the Government of India, the forests yielded in 1881-82 a revenue of £631,500, while the charges amounted to £393,000. Of this outlay £290,000 was expended upon cutting and carriage of timber and other matters connected with the collection of revenue; while on the formation, protection and improvement of the forests the outlay was £103,000. But the revenue is increasing steadily, and may be expected to reach a very large figure. In 1864 the first attempt was made to put together the financial results of forest administration in the different provinces, and the progress which has been made since that time will be seen by comparing the average annual figures of the five years commencing with 1864-65, with the figures for 1881-82 and 1882-83. These figures include receipts and charges of the provinces immediately under the Government of India, as well as of the Presidencies of Madras and Bombay*.

	1864-65 to 1868-69	1881-82	1882-83
Average per Year			
Revenue	£360,000	£870,000	£950,000
Expenditure	£220,000	£550,000	£600,000
Surplus	140,000	320,000	350,000

By way of comparison, the average receipts and charges of the State forests in France and Prussia will here be stated. The figures from France are taken from the "Annuaire des eaux et Forêts" for 1884, and it should be noted that the receipts are those for 1880, while area and charges relate to

* The Forest Revenue for the three Presidencies in 1883-84 has been @ 1,040,000

1884. The figures from Prussia are taken from the "Forst and Jagd Kalender" for 1884, and all relate to 1883-84. In both countries the State forest officers have also the general control of a large area of communal forests. The receipts include only cash receipts, and not the value of wood and other forest produce given gratuitously to right-holders and others. Outlay of capital and extraordinary charges, such as those for the construction of roads and buildings, the planting up of large areas of waste, and the operations for restoring the forest growth on low mountains in France, are included in the current expenditure of the year, and this is also the practice in India. The figures for France do not include those relating to the forests in Algeria.

	FRANCE	PRUSSIA
Area in square miles	3,876	10,246
Area in hectares	£1,003,948	£2,653,913
Revenue	£1,405,104	£2,618,570
Expenditure	£641,508	£1,625,725
Surplus	£763,596	£992,845

Both in France and Prussia the gross and net revenue per square mile is much larger than in India. A comparison of the rates per square mile would be without meaning, as part of the Indian forest revenue is derived from areas outside the Reserved Forests, while for France and Prussia the figures only represent the revenue of the State Forests. In these countries regular and systematic forest management has existed for several centuries, and the result may be seen in well-stocked forests, with a regular gradation of ages, which yield large annual crops of timber and other forest produce. In India the first real attempt to introduce systematic forest management is barely 30 years old.

But though the working of the Indian forests is as yet in its infancy, the principles followed are the same as those upon which the State Forests of France and Prussia are worked, the chief aim being steadily to improve their condition, and never to cut more than the annual production by natural or artificial means will justify. Forest management, which aims at these objects, requires the following measures as essential conditions of success. *First*, effective protection; *second*, a good system to secure the regeneration of the forest, either naturally by self-sown seedlings or coppice shoots, or artificially by planting, sowing, and other cultural operations; *third*, good lines of communication to facilitate protection, the working of the forest, and the export of produce; and *fourth*, well considered and methodically arranged plans of working.

In the matter of protection, great success has been achieved, and the beneficial effects manifest themselves in the improved conditions of the forests. One of the main points gained has been that over large areas it has been possible to put a stop to the annual forest fires. As is well known, one of the peculiarities of the Indian climate is that in most parts of the country the year is divided into a dry and a wet season. During the dry season, which never lasts less than five months, but generally much longer, the grass and herbs, the leaves, twigs, and rootlets on the ground get so exceedingly dried up, that a spark is sufficient to set large tracts on fire. Only the dense evergreen forests of the Himalaya and of the moistest regions of India are safe from these fires; but in the deciduous forests which prevail in the plains and on the lower hills, the fires of the dry season are an annually recurring event. They are lighted by the hunter to clear the ground; by the herdsmen, who burn the old grass in order to get fresh herbage for their cattle; by the hill tribes, who raise their crops of rice or millet in the ashes of

the forest, which they cut and burn; or they originate through the carelessness of travellers. The injury done by these fires to the forests is incalculable; trees are killed or hopelessly injured; seed and seedlings are destroyed wholesale; and the ground is hardened and impoverished. In the provinces under the Government of India, 4283 square miles out of 18,400 were effectually protected in 1881-82. In some provinces a much larger proportion was reported to have been saved; thus, in the Central Provinces, one-half of the first-class reserves was without fires in 1881-82, and in Berar two-thirds. When the idea was first started it was announced as Utopian, and the attempt to put a stop to the annual jungle fires was regarded as a hopeless undertaking. Success was only achieved through indomitable perseverance, and at the cost of great personal exertion and exposure during the hottest part of the year. In the Central Provinces success in this respect has been chiefly due to the energy and perseverance of Colonel G.F. Pearson, who was appointed Conservator in 1863, and of Major Doveton, who succeeded him in 1868.

The reward has been a wonderful change in the condition of the forests. Before protection commenced they were often nothing but a thin and open scrub, with here and there a few trees which had managed to grow in spite of the fires. Year after year, as fire protection continued, this open scrub was replaced by a dense growth of trees, bamboos and shrubs, and the large blanks, formerly covered with high grass, gradually got stocked with self-sown seedlings and coppice shoots. The task of continuously protecting those forests against the annual fires would be hopeless, if the grass, generally the chief source of danger, were not killed out by the dense cover of the forest, which has gradually become stocked. So far the improved condition of the growing stock. The improvement of the soil is equally

important; but here a remarkable fact should be mentioned. Black moist vegetable mould, such as covers the ground in Beach and other forests in Europe, has not yet been observed in the Indian fire-protected forests; and it should be added that such black vegetable mould is not found as a rule in the evergreen forests of tropical India, through which the annual fires do not pass. In the deciduous tropical and subtropical forests which are protected against fire, leaves and twigs crumble into dust during the dry season; the surface of the soil is dark coloured, but, as far as experience up to the present time has gone, no layer of moist vegetable mould is formed.

Fire protection benefits the less valuable kinds equally with those species which are valuable. Planning and other cultural operations are therefore necessary, not only in order to stock blanks, bare plains or hillsides, with trees, but also to increase the proportion of the more valuable species in the forests. For this is a peculiarity of forestry in most parts of India, that those trees the timber of which is marketable are often mixed with other kinds for which there is no demand. Thus, in what are called the Teak forests of British Burma the teak tree forms a small proportion of the forests, less than 10 per cent, and hence it is of the utmost importance to plant teak and otherwise to favour the growth of this tree at the expense of the other less valuable kinds. From a late report on the Burma forests, it appears that up to the 31st March 1883, 11,221 acres had been planted with teak. This, obviously, is only a small commencement, and teak must be planted on a much larger scale in Burma in order to place the forests in a position to yield eventually the large supply which it is hoped they will furnish. The difficulty hitherto has been that those tracts where the teak grows best are extremely feverish, and that labour is scarce and expensive. Several plans have been tried, but that which seems

likely to lead to the best results is to induce the Karens, who inhabit these forests, to plant teak in their hill clearings (Taungyas), where they raise a crop of rice, with vegetables and a little cotton, in the forest which they have cut down and burnt. While the crop is on the ground, the teak remains small, but grows rapidly afterwards. Major Seaton, Conservator of Forests in the Tenasserim division of British Burma, has the great merit of having succeeded, in 1868, in starting this system, which had been first suggested in 1856. The bamboos, which form extensive forests in the teak region, mostly flower gregariously all at once over large tracts, and after ripening their seed they die; the stems of the bamboo fall, and the ground is covered with a dense mass of dry stems lying across each other. Attempts have been made during the last few years to burn and clear these areas and plant teak, and it is possible that this also may eventually be developed into a good system.

The total area planted with trees of all kinds in the provinces immediately under the Government of India aggregated 33,000 acres on the 31st March 1882. In the Presidencies of Madras and Bombay also large areas have been planted, and cultural operations of all kinds progress vigorously wherever forest management has been started in India. In addition to the regular plantations there has been much sowing and planting in the forests in order to aid natural reproduction; the areas thus operated upon, however, are not included in the figures here recorded. Broadcast sowing of seed, without any previous preparation of the ground, has not hitherto yielded good results. Attempts have also been made to favour the growth of the more valuable, by cutting back saplings of the less valuable kinds. The cutting of creepers is an operation peculiar to India. Many forests, when first taken in hand, are found to be full of these large climbing shrubs, the stems of which, as thick

as a man's thigh but as flexible as a rope, were seen winding round the trees or hanging upon them, while the dense foliage of the climber completely smothered the crown of the tree. Teak and Sal are frequently attacked in this manner, and the result is stunted growth and irregularly shaped stems. The eradication of these creepers has generally been one of the first operations when the protection of a forest was taken in hand, and in many of the more valuable forests they have been eradicated. When a systematic treatment of the Indian forests was first attempted, it was found that in most cases those forests which were accessible were exhausted, and that only those which were remote and difficult of access contained timber and other material fit for sale. The necessity of making these forests available by improving the export lines and other means of communication forced itself early upon the attention of those who were charged with their administration. In Burma, where the teak timber is floated down from the forests, large areas had fortunately been protected by natural obstructions in the streams, which prevented the export of the timber growing above them. In 1858 operations were commenced to open out these obstructions by blasting the rocks in the rivers, and ever since that time this work has been steadily continued.

In Oudh, Captain E. Wood, the Conservator of Forests, commenced early to divide the forests in his charge into blocks, and so to arrange the lines which separate these blocks that they might be used for the export of timber. The value of the Oudh forests has been greatly enhanced by the complete system of roads (about 900 miles in length) which have thus been made.

Large forests cannot be managed without a well considered methodical plan of working, and the first step in this direction is the preparation of good topographical maps. At the outset it was necessary to be satisfied with maps of a

very rough kind – mere sketch maps. As operations progressed and more accurate maps were required, it was possible in some cases to use the work of the great Indian Survey, but frequently special maps were needed; hence in 1872 it was found convenient to organise a special staff for the survey of forests, and this was done by Major F. Bailey, of the Royal Engineers. This staff, though employed exclusively for forest work, is under the supervision of the Surveyor-General of India.

The necessity of regulating the working of the forests by a carefully devised plan of operations was felt long before accurate maps were available. The first working plans were necessarily of a rough and preliminary kind, and intended to provide for a short series of years only. Thus the Burma Forest Report for 1862-63 contains the outlines of a plan for working the Teak forests in that province during a period of twelve years. This plan was revised in 1868, and again in 1880. For one of the finest Sal forests in the Eastern Duars – the Buxa forest – Dr Schlich, while Conservator of Forests in Bengal, proposed (in 1873) a plan, laying down the work to be done during a period of eight years. In the same manner, the working of forests in other provinces was regulated by preliminary working plans drawn up for short periods. The necessity of employing a special agency for this purpose has now been recognised, and for the provinces under the Government of India the control of this most important branch of work has been entrusted to the Inspector-General of Forests.

It will now be well to give a brief account of the staff of officers employed for forest administration in India. In 1864 the writer of the present paper, who since 1856 had been Conservator of Forests in Pegu, and later in the whole of British Burma, was appointed Inspector-General of Forests, in order to advise the Government of India and the

Local Governments in regard to the organisation and management of forest business. This appointment is now held by Dr. W. Schlich, who joined the Indian Forest Service in December 1866. The chief forest officer of one forest circle is styled Conservator of Forests. In several provinces there is only one circle and one Conservator. On the 1st January 1884 there were fifteen Conservators, viz.:-

In the Presidency of Madras	2 Conservators
In the Presidency of Bombay	3 Conservators
In the Province of Bengal	1 Conservator
In the Province of North-West and Oudh	3 Conservators
In the Province of Punjab	1 Conservator
In the Central Provinces	1 Conservator
In the Province of British Burma	2 Conservators
In the Province of Assam	1 Conservator
In the Province of Berar	1 Conservator

Each forest circle is divided into a number of divisions, each division forming the charge of a superior officer, who is styled Deputy or Assistant Conservator. Divisions are subdivided into ranges or executive forest charges. The extent of ranges varies exceedingly, according to the greater or less importance of the forests comprised in them, and according to other circumstances. Eventually an area of 20,000 acres, or 30 square miles, will probably be found to be as much as can well be managed by one executive officer or forest ranger, though in special cases, such as large plantations or other forests intensively worked, a ranger can only manage a much smaller area. It has been stated that the area of Reserved Forests on 31st March 1882 amounted to 30,000 square miles; hence, if the organisation were complete, the executive management of this area would require a staff of 1000 forest rangers or wood managers.

Ranges are subdivided into beats in charge of forest guards, whose duty is confined to the protection of the forest.

The Indian Forest Service is thus divided into these main branches – the Controlling or Administrative Staff (Conservators, Deputy and Assistant Conservators) in charge of forest circles and divisions; the Executive Staff (Forest Rangers) in charge of ranges, and the Protective Staff (Forest Guards) in charge of beats.

Only the Controlling or Administrative Staff is recruited from Great Britain, while the officers of the Executive and Protective Staff are all natives of India. The number of Conservators, Deputy and Assistant Conservators, in all parts of British India does not exceed 150, and it is not likely that this number will be much increased in future. Of these appointments, some will always be filled by the promotion of forest rangers, natives of India, who have distinguished themselves as Executive Officers, so that the number of candidates required annually from Great Britain to fill vacancies is limited. Since 1867 great attention has been paid to the selection and professional education of the candidates destined to fill appointments in the Controlling Staff. It has been recognised that the candidates selected must possess a thorough knowledge of pure and applied mathematics (up to and including plane trigonometry and the binomial theorem), and of selected branches of natural science; and that before going out to India they must make themselves familiar with the administration of large forest domains in those countries where extensive areas of State and Communal Forests are managed according to a regular system.

The formation of the Government forest domains in India, and the organisation of their management, has been a large undertaking, and the progress which has been made in this work could not have been accomplished had the

experience gained in forest administration in Europe not been utilised; and in future it will be necessary to maintain an intimate connection between forest administration in India and in those countries of Europe where scientific forestry is based upon the experience of centuries. Climate and the species of trees are different in India, but the principles upon which systematic forestry is based, are the same in all countries, and the aim in future must be, as it has been in the past, to build the system of forestry in India, not upon the ideas and theories of individual men, but upon the results which long experience has furnished in those countries of Europe where scientific forestry is oldest and best understood.

So far regarding the officers of the superior staff, upon whom mainly rests the responsibility of building up forest administration in India. In the case of officers of the protective staff, or forest guards, what is necessary in order to ensure efficiency are local knowledge, a strong constitution, active habits, honesty, and general intelligence. Higher qualifications are required from forest rangers, and for the purpose of training candidates for the large and important staff of forest rangers, a Forest School has been established at Dehra Dun, in Northern India, to which four forest divisions, situated in the plains and in the hills of the Himalaya, have been attached. The arrangement is that eight months in the year are devoted to practical work in the school forests, while the remaining four months, during the slack season in summer, are devoted to theoretical instruction in mathematics, the natural sciences and forestry. All candidates are taught surveying in the field and in the office, and Major Bailey, who organised the Forest Survey, has been appointed Director of the Forest School. As the students at the Forest School come from Burma, Assam, Madras, Oudh, the Punjab, and from other provinces, where they all speak

different languages, it is necessary to give the instruction in English; and it has been settled that no candidate shall be sent up from the different provinces who has not received a good general education. Recently a lower class has been established for those who do not aspire to the Forest Ranger's Certificate; these men are taught in the Hindustani language, and they study for the Certificate of Forester, a class intermediate between Forest Rangers and Forest Guards.

At an early date the necessity of providing handbooks for Indian Forest Officers was felt. In 1856 Dr Gibson brought out a handbook to the forests of the Bombay Presidency. In 1861 Dr Cleghorn published his well-known work on the "forests and Gardens of South India." His successor in Madras, Colonel Beddome, commenced in 1869, and completed in 1873, his "Flora Sylvatica of the Madras Presidency." In 1874 appeared the "Forest Flora of North-West and Central India," which had been commenced by the late Dr J. Lindsay Stewart, Conservator of Forests in the Punjab, and which was completed by Dr Brandis. In 1877 was published the Forest Department Code, which was intended to regulate the conduct of business and the rendering of accounts. In the same year appeared the "Forest Flora of British Burma," by the late Sulpiz Kurz, Curator of the Herbarium at the Calcutta Botanic Garden. A general Manual of Indian Timbers was brought out in 1881 by Mr J.S. Gamble, then Conservator of Forests in Bengal, and now Conservator in the northern circle of the Madras Presidency; and in 1882 two most important Manuals for Forest Officers were published by Mr Baden-Powell of the Bengal Civil Service, who for many years had been Conservator of Forests in the Punjab, and who in 1873 and 1874 had been acting as Inspector-General of Forests to the Government of India. The first of these works treats of the Land Revenue Systems and Land Tenures of British India; and the second is a

Manual of Jurisprudence for Forest Officers – viz. a treatise on the forest law and those branches of the general civil and criminal law which are connected with forest administration.

A sketch of the management of the Crown forests in England, of the woodlands or private estates in Scotland, and of forest management in Germany, Austria, and France, is contained in two useful small volumes (published in 1873, and written chiefly by Major Campbell Walker, now the Conservator of Forests in the Southern Circle of the Madras Presidency, with contributions by Mr Gustav Mann and by Major Pearson. An excellent little book on Silviculture by one of the Professors at the French Forest School – the late M. Bagneris – was published in 1882 by Messrs E.E. Fernandez and A. Smythies, both attached to the Dehra Dun Forest School. A handbook on the organisation and valuation of forests on the Continental system was published in 1883 by Mr J.L.L. Macgregor, an officer in the Bombay Forest Service. Besides these handbooks and manuals, numerous reports and other official documents on the subject of Indian forests have appeared.

In July 1875 Mr Baden-Powell and Dr Schlich issued the first number of *The Indian Forester*, which was commenced as a quarterly magazine, and is now a monthly periodical on Indian forestry. This journal, which was edited by Dr Schlich until 1878, and by Mr Gamble until 1882 is now in the hands of Mr W.R. Fisher, the Deputy-Director of the Forest School, and officiating Director during Major Bailey's absence in Europe.

The object of *The Forester* was to supply a medium for the inter-communication of ideas, and the record of observations and experiments; and not only has this object been accomplished, but those who have contributed to its pages have given material help towards building up a system of

scientific forestry in India. One of the great wants felt at the outset was a suitable terminology, or a collection of technical terms required for this branch of applied science so recently introduced in India. A series of articles appeared in the magazine written by several of the most competent Indian foresters, in which the English equivalents for the technical terms which have been long in use in forestry on the Continent of Europe, were discussed, and many technical terms are now well established.

Indian forest officers have at different times been employed to assist in organising forest administration in various British colonies and dependencies, and the substance of the reports submitted by these officers to the colonial governments, or other communications sent by them, have from time to time appeared in *The Indian Forester*. Thus in 1876 Major Campbell Walker was requested to examine the forests of New Zealand, and he submitted proposals for their organisation to both houses of the General Assembly of that Colony in 1877. In 1880 Mr R. Thompson, Deputy-Conservator of Forests in the Central Provinces, was deputed to the island of Mauritius for a similar purpose. The forests of Ceylon were examined and reported upon by Mr F. d'A. Vincent in 1882. An Indian forest officer (Mr E. Dobbs) was appointed in 1882 to the charge of the forests in Cyprus, and another (Mr D.E. Hutchins) is at present serving in the forest department of the Cape of Good Hope. In this manner *The Indian Forester* has been enabled to give information regarding the progress of forestry, not only in India and Europe, but also in other parts of the globe. The plan of this periodical was first started at a conference of forest officers held at Allahabad in January 1874. A second general conference of forest officers from all provinces of India was held at Simla in October 1875. The advantages of periodical meetings of foresters charged with the management of

extensive estates are well recognised wherever forestry is practiced. The results of forest management do not show at once, and the mistakes which may be made in the organisation and treatment of forests do not as a rule manifest themselves until a generation of foresters has passed away, and the work has gone into the hands of new men who had nothing to do with the framing of the original plan. When a bridge is built or a railway is made, it is not generally long before the defects of plan and construction manifest themselves; but the wrong treatment of a forest may not manifest itself for a long series of years. Certain questions, therefore, of forest management should never be left to the judgement of individuals, but should be submitted to the discussion on the spot of a number of competent and experienced foresters.

A free interchange of views on important questions of forest management in India has been attained by periodical meetings of forest officers, and it is the recognised practice, as a rule, of the superior officers to consult the local foresters regarding all important measures proposed by them, and to discuss with them on the spot in the forests all questions that may arise concerning the management of the estates entrusted to their charge. A useful interchange of views on professional subjects has been started in the pages of *The Indian Forester*, in regard to the "Manual of Indian Sylviculture," a work undertaken by Mr E.E. Fernandez, and the need of which has been felt ever since the first attempt was made to teach Sylviculture at the Forest School of Dehra Dun. A rough preliminary edition of portions of the work was printed and circulated, and the notes and critical remarks regarding it have been published and discussed in *The Forester*. Useful suggestions regarding Indian Sylviculture are scattered in many official Forest Reports and other publications, but no attempt had been made to treat the

whole subject in a systematic manner. The undertaking is large, new, and difficult, and some time must elapse before it can be completed. The study of books may be said to be a necessary evil, in contradistinction to the study of nature in the forest; but whether evil or not, good handbooks are necessary, and it is to be hoped that the "Handbook of Indian Sylviculture," when completed, will be the first of a series of handbooks which will facilitate the study of Indian forestry in all its branches.

These handbooks and periodicals, reviews and reports, however, are only means towards the ultimate object aimed at, and the object is, to promote the wellbeing and to advance the prosperity of the people of India. Well may the question be asked, whether the people of India will really benefit by the establishment and good management of these large State forest domains.

The advantages which the people of India will derive from the maintenance and further development of forest conservancy are of two classes – direct and indirect. The direct advantages are easily defined. They comprise the provision of a permanent and sufficient supply of timber wood, bamboos, and other forest produce for the agricultural population, for towns, railways, shipbuilding, iron smelting, and for export. It might be argued, and it has ere this been argued, that this object might have been accomplished in a different way, and it has been urged that as the demand for timber and other forest produce increases, the requisite supply will at all times come forward without the intervention of Government.

In certain cases and under favourable circumstances private enterprise can doubtless be relied upon to create forests and to supply the demand for forest produce, and there is one instance in India which illustrates this in a

remarkable manner. As is well known, the southern part of the Indian Peninsula produces no coal, and there is no prospect of finding it. Hence, the town of Madras, with a population of 400,000 souls, large cotton mills and other factories, Government establishments, and the two railways which have their terminus in that city, are all dependent for their fuel requirements upon sea-borne coal from Bengal, Great Britain and Australia, and upon wood.

Wood, though it commands a high price at Madras, has hitherto been cheaper than sea-borne coal, and the consumption of it is considerable. It has been variously estimated at from 80,000 to 100,000 tons a year, and the mean retail price during the three years ending with 1880 was about 20s. a ton of 2240 lbs. At this price it pays traders to carry firewood to Madras from distant woodlands, 44 miles by cart, in addition to the same distance by boat – a total distance of 88 miles. But formerly there were woodlands much nearer the town, and the price was less. As these woodlands became exhausted through reckless cutting, and prices rose, experiments were made, in the first instance by Government, to plant *Casuarina equisetifolia*, a tree indigenous on the coast of Burma, which was found to thrive well on the belt of sand stretching along the Madras coast. The matter was taken up by landholders and others, and the result is that within the last 20 years upwards of 30,000 acres have been planted by private enterprise to provide for the supply of the town, and that from Madras to Coromandel in the north, a length of 24 miles, and to the Palar river in the south, a length of 40 miles, these private Casuarina plantations form an almost continuous belt of forest about half a mile wide along the coast. It was most fortunate that as the natural woodlands within easy reach of the town had become overworked and ceased to yield, private enterprise stepped in and supplied the deficiency. A regular system of

management has developed, and besides yielding fuel for Madras and a handsome income to the proprietors, these plantations have fixed the sand along the coast, and large areas of wasteland hitherto almost useless have been utilised.

This is a remarkable and almost unique instance of forests being created and maintained by private enterprise in India. The conditions, however, were exceptionally favourable; the planting costs very little, the operation succeeds with hardly any risk of failure, the crop is fit to be cut after eight years, and the outturn is very large. Under less favourable conditions private enterprise has not come forward to supply the demand for fuel by the railway or for iron smelting, or the demand of other towns. As a matter of fact, had Government not stepped in to arrest the denudation of the country, by protecting the remaining forests and by planting, no action would have been taken in the matter, and the people of India would have suffered. Within the last fifty years the extension of cultivation has been so rapid, that in many districts large tracts have been completely cleared, the forest rooted out, and the land brought under cultivation. Such tracts may be seen in Burma, in the Central provinces, in South Berar; at the foot of the Himalaya, and in many other parts of India. Hardly in any case has the foresight of the agricultural population induced them to leave forests standing for the supply of timber fuel, bamboos, and other forest produce. The fertile plains of Tharawadi in Burma, which were almost continuous forests in 1856, are now open rice fields, with groups of trees and small forests, it is true, scattered among the fields, but they owe their existence to the fact that they chiefly consisted of Teak, and that Teak was a Royal tree, the cutting of which was prohibited by government. In other districts, where there was no Teak, no trace of the old forest is left - the people suffer great

inconvenience, and the formation of village forests is contemplated. In the Central Provinces forests have been preserved by Malguzars or Landholders on their estates, because the timber or bamboos in them were valuable and could be converted into money. In the drier parts of North-West India, where forests are scarce, there has, in some cases, been a tendency towards the preservation of forests, either as sacred groves or for hunting, or in some cases to provide fuel for iron smelting, to protect the water supply in springs and streams, to provide fuel for towns, or to secure a supply of cattle fodder in times of drought and scarcity. But there has been no organised and effective action to accomplish these objects.

As a rule, it may be said, that unless Government had stepped in and had reserved forest tracts, many districts would have become denuded and the people would have suffered. Had the Government not interposed after the annexation of British Burma, the Teak forests of that province would have become annihilated, and there would be no prospect of a permanent supply of teak timber from that quarter. The vast and thickly cultivated plains of Northern India depend for their timber, bamboos, and other forest produce entirely upon the forests at the foot of the Himalaya, and had Government not interferred to preserve them, they would have become gradually exhausted.

Cattle fodder has been mentioned among the produce expected to be furnished by the public forest domains in India. Even in this respect Government has had to take the initiative, and action on a large scale is contemplated in the drier districts of Northern and North-Western India. In the small British districts of Ajmere and Merwar in Rajputana, which have a dry and hot climate, with a scanty and uncertain rainfall, the waste land and hills, in that portion which is not included in the large private estates, were

originally the property of the State. At the land settlement in 1850, however, the waste land and hills were included in the common land of the villagers, and their management was made over to them, the result being that these lands, were gradually denuded. What wood there was, was cut and sold, and the hills became bare. In the drier districts of India grass grows much more plentifully under the partial shelter of trees, though under the cover of dense and closely stocked forests it is killed out. Hence, in many parts of India the first effect of denudation has been most keenly felt in seasons with insufficient rainfall. The occurrence of such exceptionally dry seasons is unfortunately not uncommon. As the hills and waste lands in Ajmere were denuded, not only wood for the people become scarce, but sufficient pasture for the village cattle was no longer obtainable. Moreover, the water supply in wells and streams became uncertain; many of the tanks constructed by Colonel Dixon, who for many years governed these districts in an admirable manner, were rendered either useless, or their usefulness was greatly impaired, because the smaller tanks silted up from the sand and loose soil washed down from the naked hills, and because in many cases the bunds were breached by sudden floods rushing down the bare hills sides. Action became necessary in the interest of the people, and in 1874 a special regulation was passed, enabling Government to take up any tracts of the common lands, for the purpose of forming State forests, certain rights in them being secured to the villagers. Under this regulation upwards of 100 square miles of hills and waste have been taken up in these districts, and they have now been effectually protected for nearly ten years. These operations were undertaken in the first instance with the view of improving the water supply in the wells and tanks, upon which cultivation in these districts chiefly depends, and in course of time their beneficial effect in this

respect will doubtless manifest itself; but up to date, the principal advantage has been, that the supply of grass has increased largely. During several seasons of drought which has occurred, the increased supply of grass in the protected areas has been extremely useful. In this manner forest conservancy may be expected to mitigate the disastrous effects of seasons of drought and famine which unfortunately are of frequent occurrence in India. The importation of grain into famine-stricken districts can be facilitated by the construction of roads and railways, but cattle fodder cannot to the same extent be distributed over the country; it must either be produced in the vicinity, or the cattle must be driven away to places where pasture is available. Want of fodder and the consequent mortality among cattle has always been one of the principal evils attending famines in the drier districts of India, and this evil can in many cases be mitigated by forest conservancy. But it is not only the larger supply of grass which is useful in times of drought; the branches of several kinds of trees form an excellent cattle fodder, and during the great famine which devastated Rajputana from 1867 to 1869, the old forest preserves, which the chiefs of several native states (notably of Kishengarh near Ajmere) and large landholders had formed, were of extreme value to the people. Special permission was given to lop the branches of trees for the cattle of the towns and villages in the vicinity, and by these means many were saved from starvation. These preserves in the native states of Rajputana were of long standing; in most cases they had been formed for hunting and shooting, but in times of drought they proved extremely useful to the people.

When forest conservancy in India was first talked of, the idea uppermost in the minds of most people was that the production of large timber must be the chief object to be attained. What has been stated will have explained that in

India the business of the forester is to purchase not only timber, but also fuel, bamboos, caoutchouc, catechu, and a great variety of other produce, among which cattle fodder is one of the most prominent. The benefits of forest conservancy in regard to the last-named point have, however, only been fully recognised within the last few years, and large schemes have lately been framed by the Government of India for the establishment of extensive fodder and fuel reserves, similar to those of Ajmere and Merwar, in all the drier districts of Northern India; action in the same direction has also been taken in the Presidencies of Madras and Bombay. The chief objection hitherto raised against these measures has been that the closing of a portion of the grazing lands, which of necessity is the first step, causes inconvenience; but it is recognised that the inconvenience will be temporary, and will produce a future supply of fodder which will be far larger and far more certain than that of which the owners of cattle have been temporarily deprived.

So far regarding the direct benefits of forest conservancy to the people of India. Regarding the indirect influence of forests much has been written, but very little is as yet known with certainty. It has been maintained by enthusiastic writers that the climate of India could so far be changed by means of forest conservancy that the seasons of drought and scarcity would be less frequent. The climate of the different districts of India is exceedingly varied, and the climate of each district depends upon its geographical position, its elevation, the configuration of the ground, and upon cosmic causes which are independent of local circumstances. It is possible that among the many factors which influences the climate of a district the existence of extensive forest tracts may be one, but we have no reason to believe that the operations of forest conservancy which can be undertaken in India will materially improve the climate, or will guard

against the recurrence of seasons of excessive drought. We must be satisfied with knowing that in the vicinity of dense forests the air near the ground is generally moister during the dry season and the dew heavier than in the open country. We also know that a gauge placed above the crowns of the trees in a forest collects more rain than another placed in its vicinity at the same height but outside the forest. Nor is there any doubt that forests, if well stocked, afford effective shelter against scorching winds, and that in the hot weather the shade and shelter afforded by trees is a great boon, and is beneficial alike to man, to crops, and to cattle.

These, however, are advantages which, though exceedingly important, only affect the immediate vicinity of the forest. As regards the effect upon the climate of entire districts, there is a widely spread notion that forests tend to increase the rainfall, and that in a warm climate the denudation of a country diminishes its moisture. Much of what is known regarding the history and the present condition of the countries round the Mediterranean seems to support this theory, which has not, however, been established by conclusive evidence; and the result is that as yet there are no data to prove any climatic influence of forests except in their immediate vicinity.

Regarding the effect of forests in protecting the soil and regulating the surface and subsoil drainage, more definite data are available. As far as our knowledge goes at present we are justified in believing that the action is this: the foliage breaks the force of the rain, which therefore falls upon the ground more gradually and gently; the loss by evaporation is less; decayed leaves, moss, twigs, and other matter on the ground in the forest act as a sponge, and prevent the rapid surface downflow of the water; the soil, which is permeated by roots and is mixed with vegetable mould, is loose and facilitates the percolation of the water, which comes out at

a lower level in the shape of springs; less soil is washed away from the hill sides, and less sand and silt are carried down by the rivers.

The beneficial effect of the action of forest in this respect is chiefly felt when the ground is hilly; and it probably is greatest in a tropical or subtropical climate, where the rain comes down in torrents and evaporation is very rapid. It must not, however, be forgotten that the effect of forest upon subsoil moisture is of a most complicated nature; for while, on the one hand, shade diminishes the evaporation of the rain water, there is no doubt that under certain circumstances trees tend to dry up the soil, the roots drawing moisture from great depths, which is evaporated by the leaves. It is a common practice to dry up small swamps and wet places by planting fast-growing trees, and cases are known in India in which the effect of plantations has been to diminish the water supply in wells in the vicinity. This withdrawal of the subsoil moisture by trees is, however, limited to the land on which the trees grow, and does not affect the action of forests growing on slopes or on hilly ground in increasing the proportion of the water which percolates into the ground and reappears at a lower level. That springs in hilly countries disappear or yield less water after the forest in their vicinity has been cleared is a well-known phenomenon, and many such instances are on record in India; nor is there any doubt that streams which take their rise in dense forests flow more evenly and are less subject to excessive floods than streams which rise in a bare and open country. In 1878 a road was constructed through certain forests in Berar, portions of which had been protected against fire for some time, and had thereby become dense and heavy, while the remainder was in its original state of open scrub with a few trees. During the rains it was found that while all the streams issuing from the open forests had been in flood, those coming from the

protected portion had been flowing gently and evenly, and no damage had been done to the bridges which on that section of the road were under construction.

Open and imperfectly stocked forest, where the grass and leaves are consumed by the annual fires, has no effect, or hardly any, in protecting the soil, in regulating the water supply, and in diminishing floods. Only dense forest which is safe from fire, and the ground which is covered with, the remains of grass, twigs, and leaves, can be expected to have an appreciable effect in this respect.

The influence of forests in diminishing floods in hilly countries is now generally recognised in Europe; and in France, not only foresters, but also engineers, seem now to be unanimous in demanding that the operations for controlling torrents and planting up bare slopes in the Alps, the Pyrenees, and the mountain ranges of Central France, which have been in progress since 1860, must be prosecuted on a much larger scale, chiefly in order to diminish inundation. It does not follow from this that in all cases floods are caused by denudation, nor is it maintained that in India or in any other country floods in rivers caused by the melting of snow or by unusually heavy rain falling over large areas can be prevented by the operations of the forester; it is sufficient to know that forestry can do much to diminish the evil.

In a large portion of India, the crops depend either partially or wholly upon irrigation, and the water is derived from tanks, wells, or rivers. The tanks are water reservoirs of various extent, generally constructed by damming up a stream or river in a convenient place; but there are also smaller storage tanks which are fed only by the surface drainage flowing direct from the catchment area. Tanks of this latter description would store the largest proportion possible of the water coming from the catchment area if that

area were made impermeable to the rain which falls upon it. In such cases trees and forest upon the catchment area are injurious, and several instances have been observed where such tanks have ceased to be filled since the forest on their catchment area has become dense and heavy. It is different with the larger tanks, which are fed by springs and streams; these benefit largely by thick forest growth upon their catchment area. The area irrigated from wells in the different parts of India is very large; thus in the Madras Presidency two million acres are irrigated from wells, while three million acres are irrigated from rivers and tanks. There is no reason to believe that forest growth on level ground has the effect of raising the subsoil water level, which is tapped by the wells; but wells are frequently dug at the bottom of a valley or near the bed of a stream, and in such places there is ground for believing that the underground water stratum which is tapped by the wells will be supplied more plentifully, and that the supply will be maintained longer during the dry season, if the hills which surround the valley are clothed with dense forest growth. Wells of this description are numerous in Ajmere and Merwara, and one of the objects for forming the forest reserves in those districts was to improve the water supply in these wells.

The Indian rivers which feed the canals used for irrigation are of two classes. The Ganges and Indus and their tributaries are fed by the snow which falls on the Himalaya mountains and by the plentiful summer rains of the monsoon. The water supply of these large rivers cannot materially be affected by the small forest area which it may be possible to place under good management on those mountains. Of the other rivers which are used for irrigation, the most important are the Sone in Bengal and the Godaverry, Krishna, and Cavery in the Madras Presidency, but there is a large number of smaller streams besides. These rivers and

their feeders rise in the hills of Southern and Central India, which derive their water supply chiefly from the summer rains of the south-west monsoon. In regard to these rivers there is good ground for believing that their water supply is largely affected by the forest growth upon their catchment area, and that in some cases denudation has already done great damage in this respect.

 The Tambraparni, in the Tinevelly district, is one of the smaller river used for irrigation in India. Its catchment area is 1739 square miles, of which 1389 are in the plains and 350 square miles in the hills on the eastern slopes of the ghats. This river irrigates the large area of 170,000 acre or 265 square miles of rice fields, more than one-third of which bears two crops. It is a beautiful sight to see this large expanse of brilliantly green fields at a time when the country around is parched and barren. This river carries down into the plains a very large proportion of the rain which falls upon its catchment area, and there is good ground for believing that if the forests, which fortunately are dense and extensive near its head-waters, were cleared, a larger proportion of the rain water would be lost by evaporation, and that the supply, which now flows almost uniformly during the greater part of the year, would come down in sudden rushes after each heavy fall of rain, and would be more irregular.

In the case of another river, the Bhowani, which rises in the Nilgiri Mountains, the mean annual quantity of rain which falls upon its catchment area has been estimated at 175,000 millions of cubic feet, and of this quantity 11,000 millions or 44 per cent of the annual rainfall reach the anicut or dam where the irrigation canals take their rise. In this case, therefore, more than one half of the rain which falls upon the catchment area is lost, and there is good ground for believing that if the forests were cleared away the loss

would be much greater.

It is obviously necessary to establish by unmistakable evidence the effect which the improvement of forest growth has upon the water supply in wells and rivers, and definite proposals have long ere this been submitted to Government for a series of systematic experiments, to ascertain the extent to which the improvement in forest growth raises the water-level in well and improves the water supply in rivers. Unless these matters are proved by precise experiment, steady progress in forest conservancy, to the extent demanded by the interests of the country, can hardly be expected. The objection can always be raised, that forest conservancy has been carried too far, and that its indirect advantages are imaginary. It is necessary to place an undertaking so important for the welfare of the country upon a safe footing, beyond the risk of a reaction which might undo all the good that has been accomplished by the labour of years; but on the other hand, if the beneficial effect of forest conservancy upon irrigation has been established by actual experiment, it will be possible to find mean for extending conservancy even to those forests which cannot be expected to yield any revenue.

When the indirect advantages of forest conservancy are fully proved and recognised, the main difficulty will be to find a market for the wood produced in the forests protected, improved, and formed in the hills from which rivers used for irrigation take their rise. From this point of view it will be understood that it is an advantage to encourage the use of wood as fuel for railways or manufactories, and of charcoal for iron smelting. At first, when railways and other public works were constructed on a large scale in India, the increased consumption by them of timber and fuel may have tended towards the destruction of the forests and the denudation of the country. But this was merely a transitory

phase. Now, since efficient measures have been taken for the formation and improvement of forests in almost all parts of the Empire, the aim must be to find a market for the wood and other forest produce which, in a forcing climate and under good management, will be produced on a very large scale. There will, as a rule, be no difficulty in finding sufficient demand for Teak and other really valuable timbers; but, as already stated, the less valuable kinds profit equally by protection, and special measures will be required to create a demand for them. From this point of view, it will be understood why efforts have lately been made by foresters in India to stimulate and in some respect to resuscitate and to improve the old native iron industry, which working with charcoal and with the rich indigenous iron ores, has produced and may still produce iron and steel of excellent quality. If the efforts made in this direction are crowned with success, it will be a benefit to the country in every way. Near the coast, sea-borne coal may eventually displace wood and charcoal for most large industrial undertakings. The coal-fields of Bengal, Central India, the Nizam's territories, and Assam supply coal to a large portion of the inland districts, but there will always remain in India many tracts where wood and charcoal will continue to be used; and though the charcoal-made steel and iron of India, even if the methods of manufacture are greatly improved, is not likely to be exported, and may not be able to compete with the steel and iron imported from England, still for many purposes the native made iron is to this day preferred by the people; a large native iron industry is still in existence, and it is not impossible that iron smelting in India by means of charcoal may have a future before it.

Whatever views may be held regarding the effect of forests in regulating the surface drainage and in improving the water supply in springs, rivers, tanks, and wells, there is

no doubt that on hills clothed with forest the soil is protected, that less soil is washed away, and that less sand and silt are carried down by the rivers. There is not a district in the moister regions of India where the effects of denudation in this respect are not visible. The sand which is washed down from the denuded hills in the Hoshiarpur district of the Punjab has destroyed the fertility of large area, and ravines and torrents are numerous in the more thickly inhabited portions of the Himalaya. Even in the Nilgiris the evil will be felt sooner or later, although these hills are favoured beyond any hill range in India by gentle slopes, deep soil, and a moderate rainfall; every year masses of fine silt, which, if retained, might be a source of wealth to the European planter as well as to the native cultivator, are washed down from them into the rivers.

The Ratnagiri district on the western coast, south of Bombay, is almost bare to the crest of the ghats, and the effect of denudation has shown itself by the silting up of the streams which rise in the ghat mountains, and run a short course to the sea; some of these rivers were formerly important for the trade of the country, but now they are only navigable for small boats. The benefits, direct and indirect, which the people of India will derive from forest conservancy, if continued in a systematic manner, can hardly be over rated. A commencement has been made, but a great deal more remains to be done, and for a considerable time to come the chief work must be accomplished through the agency of Government. This may be questioned by those who consider that the agency of Government should be restricted to the utmost; but had the Government not taken the initiative, no adequate measures would have been taken, and the consequences would have been serious. In this respect India does not stand alone. In nearly all countries of Europe, in Japan, and in most colonies and dependencies

of Great Britain, the forest question has been taken up by Government, and in some countries, as in Germany, France and portions of Italy, a regularly organised State forest administration is several centuries old. In the United States it is beginning to be recognised that the present destruction of forests cannot go on much longer without serious injury to the agricultural and general interests of the country. Not only have private associations been formed, in order to encourage planting and a more careful management of existing forests, but one of the States, Massachusetts, has passed an act authorising town and cities to provide for the preservation and reproduction of forests; and in the United States Department of Agriculture a forestry division has been formed, in order to collect and disseminate information regarding planting and the management of forests.

In England there are Crown forests, but they are not very extensive; and though, when oak was first planted in them on a large scale the idea may have been to secure a permanent supply of timber for the navy, that object has long ceased to have any national importance, for abundant supplies of timber are brought from all parts of the world, and oak in shipbuilding has to a great extent been displaced by steel and iron. Moreover, the woodlands on private estates in Great Britain are extensive, they yield large supplies of timber and other forest produce, and in the moist and temperate climate of the British islands the indirect advantages of forest conservancy are of less importance than on the continents of Europe and of North America. Yet if the plan is carried out which has been formed of planting up a portion of the waste lands of Ireland, in order to make them more productive and to regulate the flow of water from the hills, some action by the State will have to be taken.

Although in India the State has taken the initiative, it does not follow that all work of forest conservancy through

out the country must be done by the British Government. At the commencement, systematic forestry was like a plant of foreign origin, and the aim must be to naturalise it. In this respect some progress has been made. The chiefs of several native states and large landholders have commenced organising the protection and management of their woodlands on the model of the Government forest, and they now send their own men to learn their profession at the Dehra Dun Forest School. Fortunately the climate in many districts is exceedingly favourable for forest growth, and the progress made by plantations and forests which have been effectually protected is exceedingly rapid. Land which twenty years ago was bare, or bore only open curb and a few isolated trees, is now stocked with dense forest from 20 to 80 ft. high. Such results of good management are more effective than any amount of teaching and persuasion, and hence the example set by Government is now followed by others.

A remarkable instance has occurred in France, within the last thirty years, of private forests created on a large scale, the example having been set by the operations of the State in the immediate vicinity. It is well known and need not here be told how the Dunes, a belt of sandhills which stretches for more than 100 miles along the coast of Gascony, between the Gironde and the Adour, were planted up by Government with "Pine maritime" (*Pinus pinaster*). This work, which was commenced in 1790, was completed about ten years ago, and the result is the conversion of 155,000 acres of white shifting sand into productive pine forests, which yield resin and timber. The larger portion of the forests thus created was sold between 1861 and 1865 to private proprietors, and this sale realised over 13 millions of francs. In land of the Dunes stretch the vast plains of the Landes, a district proverbially infertile and unhealthy. A little more than thirty years ago an attempt was made to drain this country and to

plant the pine which had succeeded so well on the Dunes; the high price of resin during the American War stimulated these operations, and the greater part of the Landes are now stocked with forests, mostly private, which cover an area of 1,692,000 acres.

The most important product of these pine forests of the Dunes, as well as of the Landes, has hitherto been resin. During the American War, and some time after its conclusion, their management was exceedingly profitable; but since the American resin and turpentine industry has recovered, the Pitch pine (*Pinus australis*) of the two Carolinas, Georgia and Florida, has become a formidable competitor of the "Pine maritime", the price of resin has consequently gone down, and it may now be necessary to alter the management of these forests, so as to aim at the production of large timber, and to plant the Cork Oak among the pines. It may be doubted whether, in the interest of the country, the sale of so large a portion of the Dune forests in 1861 was a wise measure; for, as a rule, the State is in a better position than private proprietors to make experiments on a large scale in order to determine what system of forest management is best suited to the circumstances of the case.

This lesson may be learnt, that in matters connected with the management of forests the Government may usefully take the initiative, but its measures must be so framed as to facilitate and not to discourage the action of private proprietors. In France, the amount voted for the current year for the restoration of bare mountain sides under the law of 1882 is £186,000, and very large sums have been spent for the same purpose annually, ever since the first law on the subject was passed in 1860. A large and efficient staff of forest officers has gradually been organised to carry on these operations, and it is confidently expected that eventually the hearty co-operation of village communities and private proprietors

will be secured, so that in the end the action so long and persistently taken by Government for the public benefit may result in the better management of all pastures and woodlands in the Alps and in the other large mountain ranges of France.

In India, certainly, it will be impossible for the State to provide means, for the protection and improvement of the woodlands to the extent required in order to secure to the country the full benefits expected from forest conservancy; a large share of the work must be undertaken by native princes within their territories, by landholders on their estates, and by village communities on the waste lands in the vicinity of their villages.

Landholders and native princes will be induced to preserve their forests by seeing the results of good management in the Government forests. In regard to village communities, the Government must take the initiative, and as a preparatory measure, provisions regarding village forests have been inserted in the India and Burma Forest Acts. To set forth the further measures which should be taken for the establishment of village forests in India would lead too far. It suffices to say that the object must be to constitute village forests for the benefit of village communities, or groups of villages, and to arrange for their protection and management by the community under the control of the State. Not only will these forests yield a permanent supply of wood and fodder to the people without any material expense to the State, but, if well managed, they will contribute much towards the healthy development of municipal institutions and of local self-government. In many parts of France, Germany and Italy, the old communal forests are a source of wealth to the country; the income derived from them pays for the construction and maintenance of roads, bridges, churches, school-houses, and other public buildings; and

there are many towns and villages where a large portion of the municipal expenditure is covered by the revenue derived from the forests belonging to them. But even in Europe the necessities of the present are stronger than the care for the future, and the communal forests would often be worked in a wasteful manner, if their management were not controlled by the State.

✓ Ch. 1

The growth of forestry in India has been silent, and but little is generally known regarding it. Wherever it was possible, the plan adopted has been to concentrate efforts upon limited areas, to undertake one task only at a time, and not to fritter away, by a variety of occupations, the time and strength of the staff available. Enthusiastic foresters may at times have desired a more rapid advance; but the slow and steady progress made, wherever circumstances were favourable, has proved a safe-guard against the tide of re-action, which, in India at least, not rarely sets in against projects and measures that have been pushed on too fast. If Indian forestry is permitted to continue its progress without any retrograde movement, it will, from a small beginning, grow into a large institution, which will strengthen the position of Government, and will promote the prosperity of the people.

Chapter-3

INDIAN FORESTRY

A comprehensive manual of Forestry in five volumes has now been published by Dr. William Schlich, principal professor of Forestry at the Royal Indian Engineering College, Cooper's Hill, and of the first two volumes a second edition has appeared*. At the same time Mr. Baden-Powell has published a book upon Forest Law[†]. These two truly excellent publications are the outcome of the efforts made, to introduce in the different provinces of the British Indian Empire a system of regular forest management. Commencing with 1867 young Englishmen have devoted themselves to the study of forestry, and every year a number which has varied, according to the requirements of the service in India, from 4 to 12 have gone out, after undergoing the needful training in their profession, to be employed in the Indian Forest Service. These books are the first comprehensive manuals of this subject published in English, and they have placed the professional studies of candidates for the Indian Forest Service upon a safe and satisfactory footing. Without Forestry in India these books would not have been published.

Development of Systematic Forestry in Europe

Systematic Forestry, all over the world, is a profession of comparatively recent origin. In most countries of Europe it has been the result of the rapid growth of population

**A Manual of Forestry, by William Schlich, C.I.F. Ph.D.; Vol. I. Introduction to Forestry, second edition, 1896; Vol. II. Practical Sylviculture, 1891; Vol. III. Forest Management, 1895; Vol. IV. Forest Protection (translation of Forstschutz, by Dr. R. Hess), by W.R. Fisher, B.A., 1895; Vol. V. Forest Utilization (translation of Forstschutz by Dr. Karl Gayer), by W.R. Fisher, B.A. 1896. London: Bradbury, Agnew and Co.*

+*Forest law, by B.H. Baden-Powell, C.I.E., M.A. London: Bradbury, Agnew and Co., 1893.*

within the last 250 years, but other circumstances, besides the increase of population, have influenced its development. As long as towns, villages, and the cultivated area surrounding them, were confined to the fertile lands in the plains and in the river valleys, the forests on the hills and on broken or less fertile ground, yielded sufficient timber, fuel and other produce for the requirements of the agricultural and town populations. Where the forest area was sufficiently extensive, it satisfied all requirements without material injury to its productiveness. As cultivation extended, and as the forest area was diminished, systematic treatment became a necessity and the consequence was, that gradually woodlands came to be managed like gardens, fields, meadows or other landed estates.

In most parts of Central Europe, particularly in Germany and France, the old system of management was different according to the prevailing species. On lands stocked with Oak, Beech, Birch, Hornbeam and other broad-leaved trees, the regeneration of the forest was effected, to some extent, from self-sown seedlings, to a larger extent from coppice shoots. We have historical evidence, that in parts of Germany forests of this description were managed during the 15th century in a systematic and rational manner. These woodlands were divided into a certain number of blocks, corresponding to the years of rotation adopted for the underwood. At each cutting of the underwood most of the older standards were removed, while the younger standards were left. To this day such a system, greatly improved, of coppice under standards, is maintained over large areas in Germany. It is the principal system, under which private proprietors in central and northern France manage their woods of broad-leaved trees, and the Oak-woods of Sussex and other countries of South England are treated in the same manner. High forests on the other hand of Beech and Oak,

but particularly of coniferous trees, of Spruce, Silver Fir and Scotch Pine, have from time immemorial been worked on the principle of cutting out the trees wanted for immediate use, and relying upon self-sown seedlings for their regeneration. This practice of cutting trees here and there, to meet the requirements of the moment, answered well, where the forests were extensive and the demands limited. When however the requirements of iron mines, of salt works, of glass factories and other industrial establishments assumed large proportions, when the timber trade expanded, and enormous numbers of logs were wanted to be floated, bound up in huge rafts, down the Rhine and other large rivers, it became necessary to make clearances upon a large scale and the necessity of arranging the cuttings according to a well-considered system became obvious. In the various parts of Germany this system has developed in a different manner, different according to species, mode of transport and other circumstances. This development commenced in the 16th century and has continued steadily to the present day. The history of the changes which the treatment of high forest has gradually undergone in Germany, is most interesting and instructive, but it would be impossible to set it forth on the present occasion.

In France an important step in advance was made, when in 1669, Colbert, the great Finance Minister of Louis Quatorze, issued his famous "ordinance," which among other things gave instructions concerning the treatment of high forests. The present excellent treatment, however of high forests belonging to the State in France, has mainly been built upon the systems gradually worked out in Germany.

Forestry in Great Britain and Ireland

In Great Britain and Ireland certain branches of sylviculture are well understood, plantations are made with great

skill and at a very moderate outlay per acre, osier beds and coppice woods for raising hop poles, as a rule are very successful. But the treatment of high forests has in no way developed in the same manner as in Germany, France, and, at a later period, in other countries, on the Continent of Europe. It is a fact, that under existing circumstances in Great Britain home-grown timber cannot compete with imported timber, for the simple reason, that from the beginning it has not received proper treatment. The trees stand too far apart, thinnings are much too heavy, hence the woods are open and the result is seen in short, knotty and branched boles. There are exceptions, but open, park-like woods are the rule, and these do not yield timber of first-rate quality. Another reason, why timber traders prefer imported timber, is that home-grown timber is thrown upon the market in an irregular manner. All at once heavy cuttings are made, to provide money, or for other reasons, and then perhaps nothing is cut in the same district for years to come. On the other hand, timber of the exact description required by the market is imported regularly at the principal ports of the United Kingdom, no wonder therefore that the timber trader prefers this source of supply, because it enables him to satisfy his customers at the right time. There is no help for it, if the market is to be supplied with home-grown timber, woods must be treated differently, and well-considered systems of management must be introduced, whereby a regular annual supply of first-class timber in each district shall be assured.

The reason for this state of things is not far to seek. In Germany, when the country was recovering, very slowly, from the devastation, which the thirty years' war had wrought, the steady increase of the population caused serious apprehensions, lest the supply of fuel should fail, and this apprehension of necessity led to systematic forest

management. In Great Britain, when fuel became less plentiful, the inexhaustible supplies of coal and peat came in to meet the demand. And while in Germany the treatment of high forests, the thinning of young woods and the successive cutting of mature trees, has been brought to a high state of perfection by patient research and systematic experiment, the timber requirements of Great Britain have always been readily supplied by sea with the best material from all parts of the world. And there has been another circumstance. Great Britain has never been devastated by a calamity like the thirty years' war in Germany, which put a stop to the accumulation of wealth, that, in spite of most imperfect means of communication, had commenced in the middle ages. In the German Empire more than 16 million acres, 47.5% of the entire Forest area, are at present owned by private proprietors. Speaking broadly, the wealth, such as it is, of these landowners, large and small, only consists in the land. Sheer necessity therefore compels them, to make the most of it and to manage their woodlands upon correct principles.

In Great Britain, on the other hand, the steady uninterrupted accumulation of wealth during many centuries, and the enormous value of town lands, has made the families of most landed proprietors to a great extent independent of the income derived from fields, meadows and woodlands. They can afford the luxury of huge parks, in the management of which the preservation of game and esthetic considerations are foremost. Yet, even in Great Britain, the decline in the price of wheat and other agricultural produce is making itself felt here and there among landed proprietors, their income has diminished, and in many cases it would be desirable to increase that income. In that portion of his Manual*, which deals with Forestry in Great Britain and Ireland, Dr. Schlich

*Volume I., second, edition, p.101

draws attention to the fact, that a large portion of the timber and other forest produce at present imported, might be produced in the United Kingdom, if the existing woodlands were managed in a more systematic manner, and if their area were increased by planting up waste lands. He shows that the mean annual imports of timber and minor forest produce during the year 1890-94 were valued at £26,592,000, and that they are increasing steadily. Teak, Mahogany and other furniture woods, Cork, Gum, Caoutchouc, Gutta Percha and other minor forest produce, the value of which is included in these figures, could of course not be produced in the United Kingdom, but Oak, Fir and wood pulp could easily be grown. The value of these imported articles, Dr. Schlich shows, amounts to £17,916,000 a year, and this quantity, he believes, might, under good management, be produced in the United Kingdom on 6 million acres. Dr. Schlich also shows, from official returns, that woodlands and plantations in Great Britain and Ireland, measure 3 million acres, rough pasture lands 12.5 millions, and that there is a large extent of unclassed surplus, comprising, besides inland water, turf bogs, marshes and barren mountain land, which aggregates 14.5 million acres. The rough pasture lands, yield rent as sheep-walks or are let for shooting, but most of the area here mentioned produces none or only insignificant returns. At first sight it would seem to be out of the question, that any timber grown upon this area should compete with imported timber, unless indeed heavy duties were levied upon the imported article. In Scandinavia, Russia, Germany and France wages are much lower than in Great Britain, and these countries furnish 60 per cent, of the imported timber. The imposition of import duties however Dr. Schlich does not contemplate. The production of timber, he explains, demands comparatively little labour, forests require one-tenth to one twentieth only of the labour necessary for land

under field crops*. Climate and soil are more powerful factors than wages, in regulating the cost of timber production, and these factors are singularly favourable in Great Britain and Ireland. Hence he is able to show that at present wages and timber prices the annual net rental of average land, planted with Scotch Pine and iarch, and treated under a rotation of 100 years, amounts to 7s. 6d. per acre, the entire outlay being charged with compound interest at the rate of 2.5 per cent. All land therefore, which does not now yield a rent of 7s. 6d. per acre, may if suitable, be profitably planted. These are very important facts, and those pages of Dr. Schlich's manual, in which these facts are set forth, as well as many other portions of that excellent work, might usefully be studied by landed proprietors, wood managers and foresters, as well as by estate agents in the United Kingdom.

The preceding remarks concerning the development of forestry as a scientific profession on the Continent of Europe and its possible development in the United Kingdom may serve better to explain some points in connection with the development of forestry in India.

Forestry in Japan.

The only country outside Europe, where some system of forestry has grown up independently of European methods, is Japan. It would lead too far upon the present occasion, to enter into detail, but so much may be said, that the woodlands in the plains and on the lower hills, which are well stocked with coniferous trees, chiefly with Sugi (*Cryptomeria japonica*) and Hinoki (*Chamaecyparis obtusa*) furnish all the building material used in the Empire^{**}. In his

*Volume I., second, edition, p.101

**Charles Sprague Sargent, *Forest Flora of Japan*, 1894, p.85.

excellent work on Japan, Rein designates these forests as cultivated woods (Cultur walder), and he thinks that they have all been artificially raised⁺. The Japanese believe that on the island of Nippon such forests were raised 1200 years ago. The area of these woodlands aggregates upwards of 13 million acres (18% of the total area of the Empire). On the mountains of Japan however there is no trace of any old system of forestry. Of late years however the Japanese Government have sent a number of young men to Germany for their professional training in forestry, and with the aid of a few German foresters from Bavaria, a regular Forest Department has been organized in that country.

Indigenous Indian Forestry. Sacred Groves.

In India, with the exception of small beginnings chiefly in Rajputana, of which a brief account will be given further on, the preservation of sacred groves, and of woodlands, as game preserves, has been the only attempt formerly made in this direction.

Very little has been published regarding sacred groves in India, but they are, or rather were, very numerous. I have found them in nearly all provinces. As instances I may mention the Garo and Khasia hills which I visited in 1879, the Devara Kadus or sacred groves of Coorg with which I became acquainted in 1868, and the hill ranges of the Salem district in the Madras Presidency examined by me in 1882. Well known are the Swami Shola on the Yelagiris, the sacred grove at Pudur on the Javadis and several sacred forests on the Shevaroys. These are situated in the moister parts of the country. In the dry region sacred groves are particularly

⁺Rein, Japan, Vol. II., 1886, p.225

^{*}Brandis, suggestions regarding Forest Administration in the Madras Presidency, Madras, 1883, p.173

numerous in Rajputana. In Mewar they usually consist of *Anogeissus pendula*, a moderate sized tree with small leaves, which fall early in the dry season, in December and January. Before falling the foliage of these trees turns a beautiful yellowish red, and at that season these woods resemble our Beech forests in autumn. In the southernmost States of Rajputana, in Partapgarh and Banswara, in a somewhat moister climate, the sacred groves, here called Malwan, consists of a variety of trees, Teak among the number. These sacred forests, as a rule, are never touched by the axe, except when wood is wanted for the repair of religious buildings, or in special cases for other purposes.

A remarkable little forest of Sal (*Shorea robusta*) I found in 1864 near Gorakhpur in the Northwest provinces. A German Missionary, of the Church Missionary Society, who then had a large congregation of Native Christians, introduced me to a Muhammedan Saint, belonging to a peculiar sect, who maintained, in the courtyard of the building which he inhabited, a perpetual fire, fed with huge pieces of Sal timber. These he obtained from a forest in the vicinity of the town, which I visited. The forest was in good condition, and well protected. Nothing was allowed to be cut, except the wood required to feed the sacred fire, and this required the cutting annually of a small number of trees which were carefully selected among those that showed signs of age and decay. The Saint was known all over the country as Mian Sahib, the Right Reverend Gentleman. He was most liberal minded and was on friendly terms with the Missionary, whose schools he helped to support. In 1857 Gorakhpur had for a considerable period been in the possession of the Mutineers, and during the whole of those troubled times he was able to protect a number of native Christians with their families, who had remained at Gorakhpur, and who had sought shelter in the buildings which he occupied.

Game Preserves

Game preserves have been established and maintained by native Chiefs in many parts of India, particularly where the climate is dry, and woodlands are scarce. The most extensive of these were the forests of Babul (*Acacia arabica*) in lower Sind. These were narrow strips of land along the banks of the river Indus, from a quarter of a mile to two miles in breadth. They were established by the Amirs of Sind and were surrounded by walls made of sun-dried bricks. On the annexation of Sind in February 1843 these game preserves became State property and now form the most valuable portion of the State Forests in that province.

In Rajputana I found in December 1869 and January 1870, on a march from Agra to Gujarat, that in the States of Bharatpur, Jaipur, Mewar (Udaipur), Kishangarh, Partapgarh and Banswara, as well as on the estates of the great feudal nobles in some of these territories, the custom prevailed, to preserve large areas of forest and grasslands, to furnish cover for game, and a permanent supply of grass, wood and timber. Under certain restrictions these preserves were generally open to the surrounding population. As an instance I may mention, that in the large Ghana which is close to the town of Bharatpur, and which at that time covered an area of 40 square miles, any one was allowed to cut dry wood. A certain class of poor people made a regular living by collecting firewood and selling it in the town. The Ghana was in charge of a faujdar, who had a guard of 100 sepoys to watch it. It supplied grass for the cattle, horses and elephants of the Raj, and 200 maunds of firewood were brought in from it daily for the different Departments of the State as well as for the workshops. It also yielded timber (Nim and Babul) as might be required. Besides the Bharatpur

Ghana, there were at that time in the State four other preserves, maintained for similar purposes, aggregating 42 square miles. In the small State of Kishangarh I found two preserves, one near the capital of the same name, the other near the town of Rupnagar. The last, which I visited on 21st December, is situated four miles south of the town on a low range of hills about 3 miles long and half a mile wide. As a rule only the cattle of the Raj were allowed to graze here, and large quantities of grass were cut and stored. But during the years of drought and famine, in 1867 and 1868, shortly before my visit, the cattle of Rupnagar were allowed to graze here, the branches of trees were allowed to be cut for cattle fodder, and I found many trees of Khejri (*Prosopis spicigera*) as lopped. The same had been done in Kishangarh and a large proportion of the cattle of these two places were thus fed and preserved during those terrible years.

Ajmere-Merwara. Bednor. Hamirgarh.

The indirect advantages also of forest protection in the dry climate of Rajputana were appreciated by some of the landed proprietors. In the British districts of Ajmere and Merwara the whole of the waste land jungle, situated in Government villages, had at the settlement of 1850 been handed over to the inhabitants, the Government relinquishing its rights in these lands. The practical result of this policy, dictated though it was by the highest motives, was disastrous. The hills and other waste lands had become denuded, the wood was used, what timber there was had been sold, and these lands were for the most part utterly barren. During the drought of 1867 and 1868 all grass on these naked hillsides dried up, the cattle perished or had to be driven away.

For their crops the inhabitants of these districts almost

entirely depend upon irrigation. The water is furnished by numerous tanks formed by embankments thrown across valleys at convenient points. Many of these tanks are old, others have been built since the country has been under British rule. Colonel Dixon, who for many years governed these districts, and whose name on my visits in 1869 and 1878 was remembered with gratitude by the people, had repaired the old tanks, and had built many new ones. The scanty rainfall in these districts does not come down continuously, but in a small number of heavy showers, which rush down the barren hillsides in torrents, and instead of filling the tanks slowly but steadily, are apt to break the bunds, or fill them with the silt which their scour has brought down. These districts I visited on my journey in December, 1869. The cattle had perished, the people had fled, large villages were entirely deserted, and the country was almost depopulated by these years of drought and famine. On many tanks I found the embankments forming the tank had been breached by sudden floods, others had silted up completely. Coming from Todgarh on 1st January, 1870. I entered the territory of the Thakur of Bednor, a Feudatory to the Maharajah of Udaipur, and the contrast in the appearance of the country greatly surprised me. In British territory the hills, which at one time had been covered by a fair Jungle of Khair (*Acacia catechu*) and Dhaukra (*Anogeissus pendula*) were denuded, the trees having been sold to the charcoal contractors of the British Cantonment of Nasirabad. Here and there an isolated useless tree of Saler (*Boswellia*) remained, showing the height which the original wood had attained. As soon however as I entered the territory of Bednor, the hills were wooded, not a tree having been felled. The Thakur's eldest son, who at that time had the management of the estate, accompanied me on the 2nd January through his forests. From the top of Bairat hill we looked

down upon the town, with its large tank and beautiful groves of fruit trees, and there he told me, how the Nasirabad charcoal contractors had come repeatedly, offering large sums if he would allow them to cut. He had refused and would always refuse their request, knowing well that the grass, which, even in dry seasons, maintained itself under the shade of the trees, and the branches of the trees themselves, had saved the cattle of Bednor in years of drought, and more than this, that the water supply in those tanks, upon which the fertility of the country depended, was maintained by the forest growth upon the hills.

A little further south, in the estates of another Nobleman, the Rao of Hamirgarh, I had the pleasure of examining woodlands managed on something approaching a regular system. On 5th January the Rao called upon me at my camp and accompanied me over the whole of his forests, covering a range of hills skirting the Bunass river, 5 miles long and about 2 miles wide. These woods were preserved for shooting, and to furnish grass and wood. Formerly a good deal of wood was made into charcoal to smelt iron, but the iron smelters had left and at the time of my visit there was no smelting. The clearances however had here been made, not promiscuously, but blocks had been cut over successively in a rough kind of rotation, the coppice on the clearances was protected, and was springing up vigorously. It gave the Rao great pleasure when I complimented him upon this attempt at regular management.

The Kans of Sorab

It is here the place to mention those remarkable wood lands, known as Kans, which are found in the moist districts of the Mysore State, the Malnad, particularly in Shimoga, and which are most frequent in the Taluk of Sorab, adjoining the

British districts of North Kanara and Dharwar in the Bombay Presidency. These Kans are patches of dense forest, sharply demarcated from the surrounding country, consisting mainly of evergreen trees, and they are only found within a certain distance from the edge of the Ghats. I examined them in April 1868, on a tour which I made through Mysore. That part of the country is well cultivated, and what forest is left on the hills is deciduous, the chief trees being *Terminalia*, *Lagerstroemia*, *Pterocarpus*, with an underwood of bamboo. Here and there however there are these patches of evergreen forest varying in size, which are carefully fire traced, so as to keep out the fires of the hot season. They are mostly private property and pay land-tax. In these woods an abundance of the Sago palm, *Caryota urens*, is found. It springs up readily from self sown seed and grows well under the shade of the large trees, which constitute the forest. The cut flower stalks yield large quantities of sweet sap, which is either boiled down into sugar, or fermented and made into palm wine. Another product of these woods is black pepper. Like the *Caryota*, the Pepper vine (*Piper nigrum*) grows wild here, but is also multiplied by planting. To enable the vine to twine comfortably round the stems, the side branches of the trees are lopped and the underwood from time to time is cleared away. The third produce of these Kans is Jack fruit, the tree (*Artocarpus integrifolia*) being plentiful. In some of these woods in the southern portion of the Shimoga district I found coffee trees cultivated. Besides the three principal kinds of produce named, these Kans also yields fuel, wood for building, branches and leaves, to manure paddy fields, Areca nut plantations and Betel gardens. It has already been stated, that these Kans vary in size. The largest examined by me was the Korkani Kan near Sorab, six miles long and about 3 miles wide. Of this however one third only was at that time occupied and

assessed. Another Kan near Sorab measured 300 acres. Most of the Kans are situated on high ground, and although the people expressed the opinion, that they were generally on better soil, this did not accord with the conclusions I formed at the time. Soil and position of the Kans near Sorab seemed to me to be similar to the dry forest in the vicinity. They do not extend further east than about 30 miles from the edge of the ghats, and they are not found in the dry maidan country of Mysore. Kans are said also to occur in North Kanara above the ghats, and to be used for rearing the pepper vine. In Hunter's Imperial Gazetteer, second edition, vol. xiii., page 65, it is said: "These Kans are caused by corresponding depressions in the substratum of laterite, which permit a surface soil of great depth to gather; whereas over the rest of the country the mould is only about 4 inches deep." This view of the case, which agrees with the local opinion previously stated may be correct, but so much seems certain, that the Kans are maintained in their present condition chiefly through protection from the annual jungle fires. Were fire allowed to enter, the deciduous trees would soon get the upper hand, pepper, the Sago Palm, and the Jack fruit would certainly disappear, since they can only thrive in the uniformly moist air of these evergreen woods, in the same way as the Betel vine (*Piper betle*) demands, besides watering, the shade of trees or the protection of mats whereby the air, in which it grows, is kept sufficiently moist.

So far regarding old and indigenous attempts at Forestry in India. The second and more important portion of the present paper will deal with the attempts made by the British Government to introduce a regular system of forest management.

*The Government-Timber Monopoly on the
Western Coast*

The first attempt at forest management was a great mistake, an act of injustice which cannot be condemned too severely. Originally started, in order to secure a permanent supply, it degenerated into the attempt to establish, without regard to private rights, a Government monopoly of timber. The districts of Malabar and Kanara on the west coast of the peninsula were ceded to the British Government in March 1792 by the treaty, which terminated the second Mysore war. At first these districts were placed under the Government of Bombay and their wealth in Teak timber at once attracted the attention of that Government. In August 1800* the Court of Directors authorized the Bombay Government, to assume the right of felling timber on behalf of the East India Company. These districts having meanwhile been transferred to the Presidency of Fort St. George, the Court's instructions remained some time without effect. It was, however, arranged that, while the administration of the country was subordinate to the Government of Madras, the forests should remain under the control of the Government of Bombay, as the timber was required for the Navy and for the shipbuilding industry at Bombay. In 1806 an Officer was appointed Conservator of Forests and in 1807 a proclamation was issued, asserting the Company's right of sovereignty over the forests, and forbidding the felling of timber by private individuals. Undoubtedly the object of the Court of Directors in issuing their orders of 1800 was, to receive a regular supply of timber for public purposes from the public forests, to which alone the proclamation was intended to

*Summary of papers relating to the Madras and Bombay Forests in
Selections from the Records of the Bengal Government, IX. Calcutta, 1852,
p.177.

apply. The Conservator of Forests however assumed much larger powers, and apparently he was supported by the Government to which he was subordinate. Commissioners of Survey, it is true, had been appointed by the Bombay Government to ascertain the limits of what might be considered public forests, but no attempt was made to settle the boundaries of these public forests, and to demarcate them. In Malabar, as well as in some of the adjoining parts of Kanara, most of the land had from time immemorial been in the possession of large proprietors, who claimed proprietary rights over the forests as well as over cultivated lands. Tippoo Sahib, the Sultan of Mysore, however, had, while he ruled these districts, in an arbitrary manner set aside these rights, particularly the right of felling timber, which he claimed as a Royal privilege. The Sultan's action was supposed to justify the proceedings of the Bombay Government and its Officers. The Conservator of Forests extended his operations over the whole country, he cut down and appropriated to the use of the Government, not only the trees of the private forests, but even those growing on cultivated lands. The proprietor was compelled to pay duty on the timber growing upon his own property, when he made use of it for his own purposes. Finally, in order to prevent ship-building by pirates on the coasts of Persia and Arabia, all exportation of timber by sea was prohibited, and thus the trade in timber was almost annihilated. For the regeneration and improvement of the forests the Conservator did nothing. The system was one of oppressive monopoly. It was complained of by all the local authorities, by the Judges, the Magistrates and the Collectors. In 1822 Sir Thomas Munro, then Governor of Madras, insisted on its being abolished. The minute* which he recorded upon this

*Major-General Sir Thomas Munro, Bart., K.C.B. by Sir Alexander Arbutnott, Vol. I., London, 1881, p.178.

subject is a model of clear and powerful reasoning. "In order to protect the property of the public and of individuals, their limits must first be ascertained, and this can only be done by a survey," and further on: "The people now submit reluctantly to our monopoly, but we should recollect, that no paltry profit in timber can compensate for the loss of their good will."

The appointment of Conservator of Forests having been abolished, it would seem, that Government, as has often been the case in India, went from one extreme into the other. No steps were taken to define the limits of the public forests and the forest rights of Government remained in abeyance. Indeed, 54 years later, in 1876, the Madras Government passed orders which would have led to the abandonment of all forest rights of Government in South Kanara. This however fortunately was prevented by the Government of India.

Forest Management in Malabar and Kanara

It was only after the Madras Forest Act had been passed in 1882, that real progress was made in the direction indicated by Sir Thomas Munro. The limits of the public forests were ascertained by careful enquiry on the spot, claims to rights of occupancy and of user within those areas were invited, and such rights, as had been proved, were either bought out, liberal compensation in land or money being given, or, if this could not be done, the continued exercise of these rights within the forest was authorized. It will readily be understood that the establishment of a just and equitable procedure in this difficult business constituted a new departure in the administration of the public forests. The procedure pursued since then in the Madras Presidency as well as, from an earlier date, in all other parts of the British

Indian Empire, was framed, on the same principles, which have regulated forest legislation in France and Germany. From the commencement it was agreed that long continued user in the public forests should be regarded as constituting a right and that in the settlement of forests these rights should be dealt with in the same manner as in Europe. The result has been, that in the districts of Malabar and Kanara considerable areas have been constituted Reserved Forests, which is the term corresponding in India to what on the continent of Europe we call State Forests. In 1862 a portion of Kanara, known under the name of North Kanara, was replaced under the authority of the Bombay Government; in the following remarks therefore North Kanara will be dealt with separately.

On 30 June 1895 the area of reserved forests in Malabar amounted to 121,676 acres, and in South Kanara to 72,795 acres. In neither district has the work of demarcation and settlement been completed, for there are still large areas of reserved lands*, (Government lands reserved from alienation), a portion of which will probably be added to the reserved forests, when their settlement comes to be completed. The area of these reserved lands in Malabar in 1895 amounted to 265,000 and in South Kanara to 656,000 acres. In Malabar the area of the reserved forests is 3.5 and in Kanara 3 per cent, of the entire area of the district. Even if further proceedings should have the result of doubling this area, the percentage would be a very small one. It has already been explained, that in Malabar as well as in a portion of South Kanara a considerable proportion of the forest is claimed by large proprietors. Nevertheless there were extensive tracts formerly not thus claimed, and it is now acknowledged generally, that if the work of demarcation and settlement had been taken in hand at an earlier

*The term used officially, though not adopted in the Act.

date, the area of reserved forests would be much larger. As population increases, the forests are more largely resorted to by the people to supply their requirements, rights of user spring up, and the area that can be obtained as State Forest necessarily diminishes annually.

In the Bombay Presidency another Forest Law, the Indian Forest Act of 1878 is in force, and under the provisions of that Act two classes of forests have been constituted: reserved forests and protected forests. The procedure in the demarcation and settlement of reserved forests is the same as in the Madras Presidency, protected forests in some respects correspond to reserved lands, but there is a difference, into which it would take too long to enter on the present occasion. The total area of North Kanara amounts to 3,910 square miles, and of this area there were in 1894 no less than 1,182 square miles (756,500 acres) of Reserved Forests or 30% of the total area. In addition there are 2,367 square miles of protected forests. North Kanara is a thinly inhabited forest country with only 114 souls on the square mile, while South Kanara has 271 and Malabar 475. The larger State Forest area however is chiefly due to the circumstance, that ever since the district was transferred to Bombay and some time previously, while it was under Madras, great attention had been paid to the protection of the forests, and this has much facilitated the work of forest settlement. This large area of forest in North Kanara will amply repay the labour bestowed upon it. Some of the most valuable Teak localities of India are here, they are now being protected against fire and the cutting of timber is regulated by well-considered working plans.

Nilambur Teak Plantation.

A most satisfactory feature in the Madras portion of these

western districts is, that in 1844 the then Collector, Mr. Conolly, commenced establishing Teak plantations upon a large scale near Nilambur in Malabar. The object which this public spirited Officer had in view was "to replace those forests which had vanished from private carelessness and rapacity." Doubtless the Court of Directors and the Government of Bombay had originally been guided by the idea, that the interest of private proprietors could not be depended upon for efficient measures to assure a permanent supply of timber. But Government, while over-riding in an arbitrary manner the rights of private proprietors, had done nothing, during a period of 22 years, to assure a permanent supply by properly managing and improving the forests. Nor had anything been done either by Government, or by private proprietors during a second period, from 1822 to 1844. Conolly determined to raise Teak forests on a large scale on Government account. This undertaking he justly designated as: "a work too new, too extensive and too barren of early return to be ever taken up by the native proprietor." At the outset two difficulties presented themselves. The first difficulty was to obtain the land upon which to plant. Mr. Conolly had selected for his operations the valley of the Nilambur river which runs into the sea at the port of Beypur, and is connected by a navigable canal with the town of Calicut, the principal timber market on the western coast. The greater part of the land however in this valley belonged to the Nilambur Rajah, a wealthy landowner, who was not prepared to part with any of his land. Fortunately one of the many religious bodies holding temple-lands happened to be in want of funds. Thus a considerable area was obtained, which was subsequently, by other purchases, increased to nearly 19,000 acres. The second difficulty was to get the Teak seed to germinate. The structure of the Teak seed is peculiar. Surrounded by an enlarged and inflated bladder

like calyx is a thick spongy mass which encloses the nut, the seeds being protected by a thick and excessively hard bony shell. Teak timber being extremely valuable holding the place so to say which gold holds among metals, and the diamond among precious stones, the seed had long attracted the attention of the people on the western coast of the peninsula as well as in Burma. Mr. Conolly was told, that in the natural forests the outer covering of the seed was destroyed by the jungle fires of the hot season, that this was necessary to enable the seed to germinate, and attempts were actually made to effect this object, by covering the seed with a light coating of dry grass and setting fire to it. Another advice was to plunge the seed in water nearly boiling. All these dodges were of no avail, but here as elsewhere the simplest plan succeeded best, plenty of water under a light covering of earth and leaves.

Mr. Conolly commenced his experiments in 1842, and in 1844 he had raised 30,000 healthy seedlings, which were planted out on deep alluvial soil near the river. These plantations were extended steadily, first at the rate of 100 acres a year, afterwards more slowly. In 1878 the area planted up aggregated 3,436 acres, and the oldest compartments, which at that time were on an average 33 years old, were stocked with a dense wood of Teak poles nearly 100 feet high. These poles find a ready market at Calicut. Some areas therefore have been cleared and replanted, and of late years a species of mahogany (*Swietenia macrophylla*) has been introduced as a mixture, a move in the right direction, for Teak thrives best when growing in company with other trees.

At a later date, a few years before North Kanara was handed back to Bombay, planting of Teak in that district also was commenced under the direction of Dr. Cleghorn, at that time Conservator of Forests in the Madras Presidency.

These operations were continued by the Bombay forest officers, and in 1894 the Teak plantations in this district aggregated 1,584 acres.

Dr. Gibson in Bombay, Dr. Cleghorn in Madras.

To the Government of Bombay and Madras belongs the credit of having been the first to organize a regular administration of the public forests within the territories under their control. The Officers selected to fill the post of Conservator of Forests in these two Presidencies were medical men, Dr. Alexander Gibson, who was appointed in 1847, and Dr. Hugh Cleghorn, who became Conservator of Forests of Madras in 1856. Both were botanists, they were good men of business, and they have done much to promote Indian forestry. Before however Dr. Cleghorn was appointed Conservator, measures had been taken to work the Anamalay forests in the Coimbatore district, which at that time were rich in large and valuable Teak timber.

The Teak tree is only found in the moister districts of tropical India and Burma, but it is by no means limited to the coast districts below Ghat, Malabar and Kanara. Indeed in that portion of Malabar which is situated above Ghat, in Wainad, are some Teak forests, which, before they were cleared out of all mature timber, were extremely valuable. And in North Kanara the most extensive and most valuable Teak producing tracts are the Sonda forests on the edge of the Deccan. The Anamalay forests are another instance of valuable Teak producing tract situated above the line of Ghats. The timber from these is exported in both directions, to the coast and to the inland districts of the Karnatak. In order to work these forests Lieutenant (now Major-General) James Michael was appointed in June 1848. He organized the cutting and transport of the timber, he brought about a

lease of valuable forests form a large landowner, the Nam-badi of Colengode, and he started a system of clearing Teak seedlings and young Teak trees in the forests, of dry leaves and other inflammable matter so as to protect them against injury by the annual fires of the dry season.

About the time that Michael commenced work in the Anamalay forests, Dr. Cleghorn was stationed as an Assistant Surgeon at Shimoga in Mysore, which State at that time was under British administration. He remarked the wholesale destruction of the forests through the system of shifting cultivation by clearing and burning, known as Kumri. It was mainly through his representations, that the attention of the Commissioner of Mysore was drawn to the necessity of forest conservancy, Kumri cultivation was stopped, and in 1868, while on a tour of inspection through Mysore. I had the satisfaction of seeing large tracts of country clothed with dense young forest which had grown up on the old Kumri clearings.

In those days the destruction of forests in India had attracted the attention of scientific men at home. In 1850 the British Association for the Advancement of Science, at their meeting in Edinburgh, appointed a Committee to consider the probable effects, in an economical and physical point of view, of the destruction of tropical forests. The members of that committee were: Dr. Hugh Cleghorn, Professor Forbes Royle, Captain R. Baird Smith, Captain (now General) R. Strachey. The report was presented to the Ipswich meeting of the Association in 1851. It was drawn up by Dr. Cleghorn, and contributed much to induce public men, seriously to consider the necessity of organizing Forest conservancy in India.

While Dr. Cleghorn was Conservator of Forests in Madras, the Government of that Presidency prohibited, by

an order of May 1860, Kumri cultivation in Government Forests without previous permission, and directed, that this permission should be given sparingly and never for spots in the timber forests. This point Dr. Cleghorn was able to carry, as he had helped to bring it about 13 years previously with the Government of Mysore, because he was known to be a true friend of the natives, he entertained feelings of warm sympathy towards them, and had made himself familiar with their mode of life and system of husbandry.

At a later period Kumri was again permitted in Mysore, and in Madras the beneficial effect of the order of 1860 has to a great extent been rendered nugatory by the tendency, which subsequently prevailed in that Presidency, to regard as private property of large portion of the forest lands, that had formerly been considered to be the property of Government. It was not until the Madras Forest Act of 1882 was passed, that these matters were finally settled in a satisfactory manner. This Act was passed while the Right Hon'ble, Sir Mountstuart E. Grant Duff was Governor of that Presidency. The good, which that Statesman accomplished in an unobtrusive manner in Madras, has never been sufficiently acknowledged. The Forest Department was reorganized and had since made fairly good progress. In the Civil Department he quietly, but with firmness, broke through the system of promotion by seniority, which had earned for the Southern Presidency the name of the "Benighted."

*The Attaran Forests in Tenasserim handed
over to Private Enterprise.*

On the east side of the Bay of Bengal the Tenasserim provinces had in 1826 been ceded to the British Government at the end of the first Burmese war. In 1827 Dr. Nathaniel Wallich, Superintendent of the Botanical Garden at Calcutta,

was directed to enquire into the resources of the country in regard both to botanical science as well as military and commercial objects. In his report upon the Attaran forests he wrote: "No forest exists which can with propriety be called inexhaustible - at least none that is liable to constant and extensive demands for timber. Private enterprise (if the forests are thrown open) will soon render fruitless all endeavours to perpetuate the supplies for the public service."

On Dr. Wallich's suggestion an attempt on a small scale was made, to work the Attaran forests on Government account, this attempt having resulted in a loss of 250 Rupees, the Government decided to throw open the forest to private enterprise. The result has been as Dr. Wallich had predicted. In 1846 the then Commissioner, Captain (afterwards Sir Henry) Durand, had determined to resume the forests and to work them on Government account, as the rules under which the forests had been thrown open, had been utterly disregarded by the lessees, The Maulmain timber merchants, who formed the bulk of the local Residents, protested, and being supported by the Calcutta Press, the Government of India gave way⁺. Mr John Russell Colvin was sent to succeed Captain Duran, the Attaran forest were relinquished, but care was taken to retain in the hands of Government the Thoungyeen and some other more remote forests.

Major Phayre in Pegu.

In December 1852, at the close of the second Burmese war, the province of Pegu was annexed to the British Indian Empire. Lord Dalhousie, at that time Governor-General of

*Summary of papers relating to the Tenasserim Forests in Selections from the Records of the Bengal Government, IX, Calcutta, 1832, p.77.
+John Russell Colvin, by Sir, Auckland Colvin, Oxford, 1895, p.151.

India, had selected the very best man for the government of the newly acquired province, Major (afterwards Sir Arthur) Phayre. Dr. Mc Clelland, like Gibson and Cleghorn a Medical Officer, who had done distinguished service in Assam, in starting, in company with Dr. Wallich and Dr. Griffith, the first Tea plantation on Government account, was appointed Superintendent of Forests. After two years of hard work, exploring the forests and endeavouring to work them, he resigned his post, and in January 1856 the writer was appointed to succeed him. On landing in Calcutta in December 1855, I had the good fortune at once to meet Dr. McClelland and thus to make myself acquainted with the leading features of the task that was before me. The main objects which I had fixed upon as my aim were threefold: (1) To protect and, as far as possible, to improve the forests, to arrange the cuttings so as to keep well within their productive powers, in order to ensure a permanent and sustained yield. (2) To make the inhabitants of the forests and the people in the vicinity my friends and allies. (3) As soon as possible to produce an annual surplus revenue. These ideas I had the honour of submitting to His Excellency. Lord Dalhousie listened with great attention, and when I had concluded, he said: "Dr. Brandis, if you succeed in carrying out these excellent plans, you will confer a lasting benefit upon the people of Pegu. I hope you may succeed, and you will have my full support in the matter. I hold it to be the duty of the Government of India to preserve the forest resources of Pegu, and not to allow them to be wasted, as the forest resources of other provinces have been wasted. Unfortunately I must leave India soon, but I trust that my successors will take the same view as myself of the Pegu forests. Should it however thus happen, that at any time the Government of India were not fully alive to the necessity of preserving the forest resources of Pegu, I hope that you will

remember what I have told you." Lord Dalhousie left India in March 1856 and died in 1860.

Pegu in 1856 was a thinly inhabited country. The population at that time is not accurately known, but may safely be estimated at 700,000 souls on 33,195 Square miles, corresponding to 21 on the Square mile. Although population has since then increased in a most wonderful manner, owing chiefly to the wisdom and determination of the first Commissioner, Major Phayre, the census of 1891 only gives 95* on the Square mile, less than the district of North Kanara previously mentioned.

System initiated in 1856.

In 1856 more than 90 per cent of the province was forest. At annexation the Teak forests had, by proclamation, been declared the property of the State, and this was in accordance with old established custom, for under the King of Burma Teak had been a royalty, all teak trees were the property of the King and Teak timber was a monopoly. So far the position of Government was clear, but I knew, that in order to have actual control, it was necessary, to keep all operations in the forests in my own hands. Hence I determined to bring out the timber on Government account, to sell it by public auction at Rangoon, and in order to enable me to do this, the Commissioner had a few days after my arrival at my request made over to me a large extent of river-frontage for a timber depot. In the forests the timber is

1891	Square miles	Population
<i>Irawadi Division</i>	17,542	1,552,000
<i>Pegu Division</i>	9,299	1,456,000
<i>Toungoo District</i>	6,354	162,000
<i>Total</i>	<hr/> 33,195	<hr/> 3,170,000

dragged to the water's edge by elephants, buffaloes or oxen, and then floated to market.

Teak however does not float, unless it is perfectly dry, and from time immemorial this has been effected by girdling, that is by making a broad circular cut through bark and sap wood into the dark brown heart wood. Within two or three days the leaves wither and the tree dies. Timber thus girdled dries completely and seasons evenly, for it is on all sides freely exposed to sun and wind. Two or three years before felling therefore, Teak trees are girdled.

Fortunately large quantities of dry timber had been left in the forests, partly felled, partly girdled. Notice had previously been given to all those who had formerly worked the forests, to remove their timber. When the time fixed by that notice had expired, I was able to commence operations and to give profitable employment to the people inhabiting the forests and living in their vicinity. By dealing with these people, the Karen and Burmans, direct and not through middlemen I gained their confidence and goodwill. At a later date I was in a position, to enable those, who by skill and energy had gained my confidence, to purchase Elephants with funds which I advanced them, and thus to bring out heavy timber, which on the hills of Pegu they were unable to manage with their oxen and buffaloes.

It was necessary to produce more revenue, than the old timber left in the forests which was mostly small and of inferior value, could be expected to yield. Before however girdling operations could be commenced, a working plan had to be prepared, in order to ensure a permanently sustained yield from the forests.

In those days Teak was the only marketable timber, and unfortunately the Teak in Burma does not form pure forests, but grows scattered among bamboos and other trees, form-

ing less than one tenth of the entire growing stock. At first sight it seemed an impossible task, to work a forest of that description so as to ensure a sustained yield. Each Teak tree cut would make room for valueless trees of other kinds, while less seed would be shed and consequently fewer Teak seedlings would spring up. I set to work at once made a rapid exploration of as many forest districts as possible and upon the data collected based a preliminary working plan, under which the trees to be girdled were to be selected during the first 6 years. The Pegu forests were divided into six divisions, one division being taken in hand annually. The main point aimed at was, to girdle sparingly and to select the trees to be girdled with care. This required constant personal supervision and the consequence was, that I was absent from headquarters the greater part of the year. In those days Major (now Major-General) Edward H. Power rendered a service to forest business in Pegu, which has never been sufficiently recognized. Power was Deputy Judge Advocate General at Rangoon, we were great friends, he saw my difficulties, for timber was coming in steadily, the contractors had to be paid, and the monthly auction sales at the Government timber depot had to be watched. Large sums of money had to be received and paid out, and in those days I had no assistant at headquarters, whom I could sufficiently trust with these large and steadily growing transactions. He offered to help me, and though his hands were full with important military matters, yet he managed, during several seasons, to superintend the business at headquarters, and to keep money matters straight. Simultaneously with the girdling operations a more detailed examination of the forests was made. Based upon the data thus obtained, the preliminary plan was revised from time to time, until, at a much later date, demarcation and organization had sufficiently advanced, to make it possible to

prepare detailed working plans for the different forest districts.

Pegu Forests thrown open to Private Enterprise.

In 1858 the forests in the adjoining provinces of Martaban and Tenasserim had been added to my charge. In 1859 the heavy outlay which at first was unavoidable, had been more than covered by the income of that year, and a steadily increasing surplus seemed certain, when circumstances arose, which for a time threatened to put a stop to the development of the system commenced. Rangoon in those days derived its importance mainly from the export of Teak timber, and the ship-building trade carried on by means of the Teak timber brought from the forests. The export of rice, which since that time has given Rangoon a much greater importance, had hardly begun. The merchants of Rangoon naturally desired their business to increase rapidly, and as soon as they realized, that the system introduced by me in 1856 would limit the quantity of timber brought to market, they commenced a vigorous opposition against it. Personally I made a point of keeping on good terms with them, and they tried hard to induce me to allow them to enter the forests and to cut the whole of the nature trees at once. With much eloquence they contended, that ships built of Teak would soon be a thing of the past, that iron would, in shipbuilding as well as for all other purposes, replace the use of wood. The demand for Teak would diminish, prices would fall and in the end Teak would be a drug in the market, and the Teak forests would be valueless.

At that time the Sepoy mutiny of 1857 had saddled the Government of India with an enormous debt. Under these circumstances the merchants of Rangoon urged me to take advantage of the high market rates for Teak then ruling, to

realize large sums by the sale to them of all mature timber standing in the forests, and thus immediately to make for Government a large revenue from the forests. A business transacted on so large a scale, they added, would give a great impulse to the prosperity of Rangoon. They appealed to my sense of duty towards the Government which I was serving, to my ambition and to my common sense, and they pictured in the darkest colours the mischief of a Government monopoly and the disastrous consequences of a refusal to back their proposals.

When my friends found that I remained firm, and that Major Phayre, the Commissioner, refused to yield to their representations, they went to Calcutta and, backed by the influence of the large and powerful mercantile firms, they succeeded. The Government of India ordered the Commissioner to throw open the Pegu Forests to private enterprise, and these orders were sent to Rangoon in February 1861.

These orders had to be carried out, and the result has been very mischievous. Fortunately however, we were not required to throw open the whole of the forests at once. By that time I had, by means of linear valuation surveys and height measurements, in all forest districts, been able to classify them according to their value. A large area of the less valuable forests were at once let out on 12 years leases, with the permission to girdle, in other districts permits were given, in some cases for 3, in others for 6 years, under which the permit holder, on payment of certain rates, became the proprietor of the timber extracted by him, being however limited in his operations to the trees girdled by the forest officers. A limited area of the most valuable forests however was for a time retained under the control of the Forest Department.

Without the cordial and unfailing support which Major

Phayre gave to my proposals, the damage done to the public interests of the country would have been much greater than it actually was.

Change of Policy

In November 1861 the measures taken by the Government of India for opening the forests to private enterprise, were reported to the Home Government. Her Majesty's Secretary of State for India strongly disapproved of these measures. His despatch, dated 24th March 1862, is the first document in the Returns on East India Forest Conservancy, ordered by the House of Commons to be printed in August 1871.

The result was, that no more forests were thrown open, and that those which had been leased out were resumed when the leases expired. Some of these contracts had to be cancelled sooner, because it was discovered that the agents of the permit holder had illicitly girdled Teak on a very large scale.

The experience gained here and in the Attaran forests has taught a lesson, which public men in India have gradually learnt. It is not safe in India at present to entrust the management of public forests to private enterprise, the State therefore must step in and undertake the management of this source of public wealth. At first sight this conclusion seems to be at variance with what has here been stated regarding the good management of private forests upon the continent of Europe. Nay, in regard to Great Britain also, the advice has here been given specially *to private proprietors*, to improve the management of their woodlands. The fact is, on the continent of Europe the State has long ago done its duty to the public in this respect. The good management of the State forests has set the example, which private proprie-

tors have followed.

This, it may justly be said, ought also to have been done in Great Britain. The Crown forests ought long ere this to have been placed under good management, in order to show the way to private landowners. The difficulties, it is true, are considerable. The area of the crown forests is small and most of them are heavily burdened with prescriptive rights which stand in the way of regular management. Nevertheless, much might be done. Real progress however seems impossible, as long as the appointment of Commissioner of Woods and Forests is given, not to a professional forester, but as is commonly supposed, as a reward for services rendered to the political party in power. That office, as well as the appointments of Deputy Surveyor in the different forests, ought long ere this to have been given to experienced foresters. The majority of Indian forest officers have received a thorough professional training, many of them have done eminent service in India, the experience gained in that country would enable them to do exactly what is wanted for the Crown forests of England. The career of an Indian officer as a rule is cut short on his attaining the age of 55, and many would be glad to retire at an earlier age, if they saw a chance of employment in their profession at home. The number of good men available is large. Her Majesty's Government would have the choice, if they could be induced to insist upon a good management of the Crown forests, so as to set an example to private proprietors.

In India there is a special difficulty. Private enterprise at present means European private enterprise, and Europeans in business in India as a rule have one aim only, that is, to get rich as quickly as possible. It is not impossible that in course of time the development of Tea and Coffee plantations will bring about a change in that respect, that is, people will gradually lay greater stress upon maintaining and im-

proving the productiveness, the capital value of their estates, than upon high dividends. Native forest proprietors in several provinces have already commenced to imitate the example set then by the British Government in forest management. What is ordinarily understood as European private enterprise in India however, has not yet attained to that point.

With the interruption caused by the orders of Government in 1861, to throw open the forests to private enterprise, the forests continued to be worked upon the system initiated in 1856. In 1861 the whole of the coast provinces of Burma were united and placed under one Chief Commissioner, Colonel Phayre, the following remarks therefore will relate to the whole of the forests of this province, with the exception of Arakan, which has no forests producing Teak. An important feature in the system initiated in 1856 was the care of the Teak trees and particularly of the self sown seedlings, which fortunately were found to be abundant in the forests. Whenever gridling operations were undertaken in any forest district, and also on other occasions, when work was going on, Teak trees were cleared of creepers, other trees overshadowing young Teak were cut, and all heavy inflammable matter, wood, branches, dry brushwood, in the vicinity of seedlings was cleared away. These operations were very beneficial, but it was clear to me from the outset that something more was wanted, that it was not sufficient to protect and aid the Teak which had sprung up naturally, but that it would be necessary to increase the proportion of Teak in the forests by sowing and planting. The small experimental plantations formed in 1856 and 1857 were successful, the difficulty however was, in the forest, where the tree grows best, always to command the needful labour at moderate cost.

Plantations.

The inhabitants of these forests, Karens and in some places Burmans, raise their crops, rice, cotton, vegetables by means of a rude system of shifting cultivation. In the dry season the forest is cut. When dry the tangled mass of bamboos and branches is fired, and after the first showers in May the paddy is sown in shallow holes made with a narrow spade. The crops are reaped during the ensuing dry season. In the following year another piece of forest is taken in hand, and so on, until after the lapse of say 20 to 30 years, the forest on the first piece has grown up sufficiently to admit of again being cut, burnt and sown. These hill clearings in Burma are known as Taungyas. The similar practice exists, as previously stated – under the name of Kumri in Mardas and under other names in other provinces. As soon as I had seen the first Karen Taungya in 1856, I determined to devise some method, by which this mode of shifting cultivation might be utilized for planting Teak on a large scale in the forests. A few small experimental plots were actually thus planted in 1856 and succeeding years, by a Burmese forester in the Kaboung forests. Upon a large scale however Taungya Teak plantations were not established until many years later.

It was Major (now Major-General) Seaton – an officer in one of the Madras regiments, at that time stationed at Rangoon, whom I had, together with other military officers, engaged for service in the forests. He gradually rose to be Conservator and having succeeded in gaining the confidence of the Karens in several forest districts, he induced them to plant Teak with paddy upon their hill clearings, certain rates being paid for each acre with the stipulated number of plants one year old. The first Taungya Teak plantations on a large scale were made in 1868, and since then the system has developed well. In 1880 an aggregate area of 2,515 acres

had thus been planted, at a total cost of 24,932 Rupees or less than 10 Rupees an acre. In 1895 the area had been increased to 35,551 acres. Other plantations by means of hired labour were made in some of the easier accessible forest districts and on the outskirts of the forests, and here also field crops were raised with the Teak. In 1895 the area of these plantations aggregated 4,001 acres.

It has been explained above that Teak is most commonly found scattered in bamboo forests. In Burma many species of bamboo are associated with Teak and most of these come into flower periodically. When this takes place, all stems of one bush cover themselves with flowers in the place of leaves, and all bushes in one district generally flower simultaneously. After the seed has ripened, the stems die and the dry stems are gradually consumed by the jungle fires of the hot season. At that time therefore the cover overhead in the forest is suddenly removed and the seedlings of Teak and other trees get a chance to grow up. Obviously this opportunity may be used to plant Teak on a large scale in these clearances. Berthold Ribbentrop, the present Inspector-General of Forests in India, has the great merit of having been the first to employ this system on a large scale. In 1895 3,744 acres had been stocked with Teak in places where the bamboo had flowered. The different species behave differently in this respect and hitherto operations have been confined to localities stocked with *Dendrocalamus strictus*, a species which flowers frequently on limited areas. Some foresters in Burma hold, that when operations are commenced in areas, such as *Bambusa polymorpha*, Teak may be planted on so large a scale that Taungya and other plantations may then be given up.

Altogether in 1895 an area aggregating 43,296 acres had been planted, chiefly with Teak, in lower Burma, and this area is being extended steadily. This alone will assure a

considerable annual yield of Teak timber. The most recent researches regarding Teak grown in Pegu under the regime of the annual jungle fires, have established the age of a tree 6 ft. in girth to be between 134 and 156 years. In plantations, however, from which fire is kept out, the growth is much more rapid, and we are justified in assuming, that in such places 90 years will suffice to bring up a tree to that size. The area artificially stocked with Teak in 1895 may be expected to furnish permanently an annual yield of 1,250,000 cub. ft. In the six years ending with 1894-95 on an average 3,281,000 cub. ft. of Teak timber were extracted from the forests of lower Burma. Hence more than one-third of the present annual yield furnished by the natural forests has already been assured by means of the plantations. This satisfactory result is entirely due to the excellent Officers who since 1868 have successively held the post of Conservator of Forests in lower Burma, and it seems right to mention here specially, besides Major Seaton, Mr. Ribben-trop and Mr. H.C. Hill.

Demarcation of Forests. Karen area.

In a country so thinly inhabited, as Pegu and the adjoining province of Tenasserim were in those days, considerable progress could be made in forest business without setting apart and demarcating those forest tracts that are to be permanently maintained as State Forests. Vigorous action in this matter was not commenced until 1876, twenty years after the first preliminary working plan of the forests had been prepared. The main difficulty consisted in the shifting Taungya cultivation. It has above been explained, that in 1848 Kumri cultivation was stopped in Mysore and that in 1860 the practice was prohibited, special cases excepted in the Government forests of the Madras Presidency, but that in both territories these orders were subsequently relaxed.

In Burma no such thing was ever attempted. Karens, and in some places Burmans, had from time immemorial lived upon the produce of their taungyas, subject only, under Burmese and English rule, to the prohibition of cutting the Royal Teak tree. Fortunately the area of forest at the disposal of Government was large and thus it was possible to assign to each village, that had hitherto practised Taungya cultivation in the forests, an area sufficient for their requirements in this respect, in which they were at liberty, without let or hindrance, to carry on their clearings, allowing for a certain increase of population. In 1895 the demarcated reserved forests in lower Burma aggregated 4,525,000 acres, and in this area were included a large number of Karen areas, aggregating 364,000 acres. This destructive mode of cultivation is now confined within definite limits. And there is another advantage. The Karens are gradually abandoning their nomadic habits, they establish permanent paddy fields in the valleys and by terracing the hills they plant gardens and groves of fruit trees. The money which they have earned by timber work and by planting Teak, enables them to purchase cattle, and they thus gradually rise in the scale of civilization. The introduction of systematic forestry has been beneficial to these rude forest tribes.

Yield of Forests

The yield of the lower Burma Forests in timber as well as in money has increased gradually and steadily and there is good ground for anticipating that this increase will be maintained.

Periods.	Teak timber extracted annually. Cubic feet.	Annual net revenue. Rupees.
12 years, 1856-57 to 1867-68	1,260,000	208,000
6 years, 1889-90 to 1894-95	3,281,000	1,865,000

Thus, while the Anamalay and other Teak forests of the Madras Presidency, previously mentioned, were over-worked when forest management commenced, so that little mature and sound Teak now remains, the annual yield in Teak timber of the lower Burma forests has nearly trebled, since work was commenced on a regular system. So much for the value of a working plan, however rough at the outset, and however incomplete the data upon which it originally was based.

To some extent the increased outturn of timber has been due to the circumstance, that large areas of Teak-producing forest had formerly been closed against the extraction of timber by obstructions in the rivers. Some of these obstructions were caused by the silting up of mountain streams coming down during the rains with great velocity, carrying with them masses of sand, silt and rubbish, which they deposited on entering the level country of the main valley. The other class was caused by boulders and barriers of rock in the bed of the hill streams. The removal of these obstructions by blasting rocks, digging canals, and other works was begun in 1858. These works are still progressing, they have opened up a large area of valuable forest, from which formerly it was impossible to bring out the timber.

Besides the Teak timber here stated, of late years timber of other kinds also, as well as bamboos, has been extracted and has contributed a small portion of the revenue. Teak timber however still remains the most important product of these forests.

The management of the Burma Forests has done good so far, as it has established two important facts:

(1) Indian forests can be so managed as to give a permanent and annually increasing yield in timber and money, while their productiveness and their capital value is increased.

(2) These results it is possible to obtain, while promoting the welfare, and securing the goodwill of the people living within and in the vicinity of the forests.

The system initiated in the coast provinces, was, on the annexation of upper Burma in 1886, introduced in that territory, and the results have been equally satisfactory. The mean annual net revenue of upper and lower Burma during the 6 years from 1889-90 to 1894-95 has been as follows:

	Rupees.
Lower Burma.....	1,865,000
Upper Burma	1,443,000
	3,308,000

The success of forest administration in upper Burma is due to two distinguished Conservators, fortunately still in the service, H.C. Hill, already mentioned, who had received his professional training in France, and J.W. Oliver, who had learnt in Germany under the late Forest-director Burckhardt. During the same period the annual net revenue of the Government forests in all provinces of the British Indian Empire, including the Presidencies of Madras and Bombay, has amounted to 7,357,000 Rupees. Thus the net forest revenue of Burma amounts to forty five per cent of that produced by the forests of the entire British Indian Empire. The forest policy in Burma was laid down by Lord Dalhousie. His far-sighted admonition at the outset, was invaluable in so far as, it gave confidence, that the mistaken measures subsequently adopted by Government would not prevail, but would in the end give way to a sound forest policy. Without that confidence the whole undertaking would most probably have come to nothing.

Forest Administration in other Provinces.

I must now ask the reader to go back to 1861. In November of that year Dr. Cleghorn was directed to proceed from Madras to the Punjab, in order to examine the forests of the North Western Himalaya, as well as the brushwood tracts of the plains. The exploration of the forests in the hills occupied the summer months of 1862 and 1863, while the winter months were devoted to the inspection of timber depots and Rakhs in the plains. His report, which was published in 1864, has been of great value in furnishing the data, whereupon soon afterwards forest administration in the Punjab was based. This important measure was taken in the Public Works Department of the Government of India, the Secretary in that Department being the late Sir Henry Yule. The orders for throwing open the Pegu Forests to private enterprise, which it will be remembered were issued in February 1861, were passed in the Foreign Department, to which at that time the entire administration of Pegu was subordinate, while the civil administration in the older provinces was under the Home Department. Soon after those orders had been passed, the subject had been reconsidered by the Government of India. Doubts were entertained, whether it had been right, to deviate from the policy laid down in regard to the Pegu Forests by Lord Dalhousie, and it was decided in future to deal with questions of forest administration in all provinces of the Empire in one Department. As the Secretary in the Public Works Department (Colonel Yule) and his successor, Colonel (now Lieutenant-General) Richard Strachey, took a special interest in forest conservancy, that Department was chosen, and one of the first measures taken was the deputation of Dr. Cleghorn to the Punjab.

In a despatch to the Secretary of State for India, dated 1st November 1862, the Government of India said: "The serious question presents itself for consideration, how we may best secure the development of some real system of forest administration, for at present it is certain, that nothing deserving the name exists. And the necessity of placing the forest business upon a definite footing, and of arranging that all matters connected with it shall be dealt with in one Department, seems obvious*." At the same time the writer of these lines was summoned to Calcutta, to advise the Government of India as well as local Governments in the matter of organizing their forest business. Subsequently, in 1864 he was appointed Inspector-General of Forests. It would be beyond the scope of the present publication, to give a comprehensive account of the further progress of forest business; it must suffice to touch upon a few points of special importance.

Protection of Forests against Fire.

I began my work in the Central Provinces, where Mr. (now Right Honble. Sir Richard) Temple was the Chief Commissioner. In December 1860, Mr. Temple had been sent to Burma on a special mission. He was present at a large meeting of timber merchants, which the Commissioner had convened to discuss with me the then burning question of opening the forests to private enterprise, and I had afterwards the privilege of conducting him over the large timber depot on the Salween river above Maulmein. Afterwards, when he fully appreciated the important interests at stake, he became a staunch friend of progress in forestry, he had appointed an excellent officer as Conservator of Forests in the Central Provinces, Major (now Colonel) G. F.

**Parliamentary Return on Forest Conservancy, Part I., India, p.7*

Pearson, and he gave to all my proposals regarding the forests of those provinces his powerful support. My chief aim in that part of the country was to make an attempt to protect the forests against the ravages of the fires of the hot season. Excepting the Himalaya, the most valuable forests in most provinces consist of trees which are leafless during part of the dry season. In these forests leaves, twigs, herbs and grass, everything becomes as dry as tinder during the hot season, the smallest spark is sufficient to set this dry material on fire, and these fires spread over the whole country. In forests and grass lands these fires have from time immemorial been a regular institution. Fires devastate in the same way the Pine forests in the Himalaya and on the mountains of Assam and Burma. Dense evergreen forests, which cover large areas in the moister regions of India, are not as a rule invaded by these fires, and there are limited tracts of deciduous forests in moist localities, which escape in favourable seasons. These annually recurring fires were chiefly due to the poor condition in which a large portion of the Indian forests was found, when regular management was commenced. In Burma the position of forest conservancy had been too uncertain, to attempt so difficult a task as fire protection, moreover the difficulties were much greater than in the drier climate and less luxuriant vegetation of the Central Provinces. But to interfere with this ancient institution, which cleared the ground in the hot season of inconvenient grass and underwood, seemed little short of impious interference with time-hallowed custom. Major Pearson himself had serious doubts on the subject, he knew that the measure would be distasteful to all, Europeans as well as natives. Nevertheless he determined to make the attempt, he selected the Bori forest, a district most favourably situated for the experiment, as it was protected on the west side by a river 50 to 100 yards wide, while on the north the

steep sandstone scarp of the Pachmarhi hills, made the inroad of fire from that side impossible. This work he commenced in the dry season of 1865. He succeeded, and within a few years he saw the condition of the forest entirely altered. The blanks were filling up with self-sown seedlings, into the extensive grass lands the growth of trees extended steadily from the edge of the forest, the trees increased rapidly in height and girth, and the fresh shoots of the bamboo became taller and stouter. The great and unexpected success in this place encouraged him to extend his operations, and to him is due the credit of having, in the teeth of powerful opposition, proved that the exclusion of the annual fires is possible, and that it is beneficial. His successor Captain (now Colonel) Doveton steadily extended the work in methodical manner, he brought down the expense of these operations to a minimum, and it is much to be regretted, that a year ago the 55 years rule has compelled his retirement. From the Central Provinces Colonel Pearson was transferred to the more important charge of the North-West Provinces, and there also he succeeded in establishing an effective system of fire protection. Of the 47.5 million acres of Reserved forests in the British Indian Empire, including forests leased from native states, no less than 17 million acres, of 36% were successfully protected from fire in 1895.

Organization of Establishments.

In the organization of forest establishments the leading principle followed was decentralization. The management of the business in each province was left entirely to the Government of that province, the Government of India reserving to itself the right of insisting upon the maintenance of correct principles. The chief Forest officer in each province was styled Conservator of forests, and in subordination

to the local Government, this officer had the control of the entire forest business in that province. At a later period decentralization has been extended downwards. In those districts, where forests existed, the officers in charge of Forest divisions were placed in subordination to the chief civil officer of that district, the Collector or Deputy Commissioner. At the outset this would have been impossible. Systematic forestry was a subject entirely foreign to the majority of civil officers, and the only plan to ensure vigorous action in the right direction, was to appoint one chief forest officer in each province, who would, subject to the control of the Local Government, take the initiative, and organize the protection, improvement and working of the forests. Take for instance the protection of forests against fire. Many, perhaps most civil officers at that time were utterly hostile to this interference with old established custom, they regarded the measures proposed as Utopian, as the outcome of theoretical speculations. A new Department therefore had to be formed in each province, and this raised grave doubts in the minds of many thoughtful public officers.

In January 1864 Sir John (afterwards Lord) Lawrence landed in Calcutta as Governor-General of India. By strong, just and considerate patriarchal government, Lawrence had so attached the people of the Punjab to British rule, as to enable him to save the British Indian Empire during the Mutiny of 1857, mainly through the resources of that province and the fidelity of its people. This result he had attained by insisting upon personal government by his district Officers. The chief civil officer he held must be supreme in his district, and there must be no departmental interference of any sort. When Lawrence came home in 1859, he took his place as a Member of the Council of India. He saw the despatches sent home in the matter of forest administration,

and he did not approve of the plan to establish a new Department, that would have charge of the waste and forest lands, and that might in many cases interfere with the supreme authority of the chief civil officer in his district.

Lawrence had summoned some of his old Punjab Officers to meet him on arrival at Calcutta, and it is no secret that he expressed to them his determination to stamp out this new fangled scheme. Lawrence was essentially a strong man, who would carry out what he had determined upon, regardless of personal considerations. But Richard Strachey, then Secretary in the Public Works Department, was in charge of the forest business. He was equal to the occasion, he succeeded in preventing precipitate action, and gradually induced Lawrence to see, that some organization of forest business was absolutely necessary for the welfare of the country. Sir John Lawrence soon learnt to value Colonel Strachey's powerful help in extending irrigation works on a large scale, and later on in devising a system of Railways to be built by the State. It was due to Richard Strachey's steadily growing influence, and to the patient perseverance and excellent tact of his successor Colonel Dickens, that Lawrence as Governor-General sanctioned a definite organization of the new Department in all provinces. I had the great satisfaction of learning in Summer 1868, the last season he spent at Simla, from Sir John Lawrence himself, that he was pleased with the organization of forest business.

Constant attacks of Jungle fever, which had commenced in 1859 in Burma, had gradually weakened my constitution and necessitated furlough. While in Europe, in 1866, I succeeded in obtaining permission to engage for the Government of India two capable young forest officers from Germany. Dr. William Schlich, the author of the excellent work mentioned at the outset, now at the head of the Cooper's Hill Forest School, who succeeded me as Inspec-

tor-General of Forests, when I left India in 1883, was enlisted by me in Hesse-Darmstadt, where he was regarded as the most promising among the men of his standing. Mr. Berthold Ribbentrop, the present Inspector-General of Forests in India, came from Hanover, where he had worked under Forest-director Burckhardt, one of the most eminent foresters in Germany.

I further was permitted, while in Europe, to organize a system of selecting annually a number of young Englishmen for forest service in India, and of giving them a professional training, practical and theoretical, in the State Forests of France and Prussia. My plans for the professional training of candidates for the Indian Forest Service attracted the attention of Sir James Fergusson, then Under Secretary of State, and through him I obtained the powerful support of the present Marquis of Salisbury, then, as Lord Cranborne, Secretary of State for India. The first batch of men, who had received their professional education in this manner, arrived in India, December 1869, and the system was continued, until in 1885 a Forest school was established in England by Dr. Schlich, in connection with the Royal Engineering College at Cooper's Hill. For the men thus sent out annually, it became necessary, to provide definite prospects of advancement, and this led to the organization of the superior or controlling forest service, which was proposed by the Government of India in September, and sanctioned by Her Majesty's Secretary of State in November 1868. Under the Conservator in each province, a graded list of Deputy and Assistant Conservators was provided, who should henceforth as a rule be recruited from England. The necessity was now recognized of employing specially trained officers in the administration of the forests, so as "to guard against the ruin of one of the most important sources of national wealth,

if the care of the forests were left to ignorant persons*." The scheme, before being submitted to the Home Government, had been circulated for an expression of opinion to all local Governments, and it is amusing now to read in the Blue Book quoted, the objections raised against it at the time by the local authorities. Sir John Lawrence however remained firm, and it was under his orders that the scheme was finally worked out.

Indian Forest Floras.

The total area of the British Indian Empire is 1,560,000 square miles, that of Europe aggregates 3,800,000. Yet the number of trees indigenous in India exceeds 1,200, while in Europe only 158 species are known. And besides these trees there are 120 species of bamboos and a large number of climbers, which play an important part in the Indian forests, being either useful or injurious. The forester finds himself bewildered by this overwhelming variety of forest vegetation. Few can attempt to acquire a knowledge of all these species, but a large number of the more important kinds the Indian Forester must know, if he is to do his work. In each country of Europe, where regular forest administration has been established, handbooks of the trees and shrubs of the forest have been published for the special use of foresters, indeed in Germany alone a considerable number of such handbooks exists. Even in the United States of North America, where no regular forest administration has been attempted by the State, and where small beginnings only have been made by private proprietors, a large work, of which ten quarto volumes already have appeared, will shortly be

**Parliamentary Return on Forest Conservancy, Part I: India, 1871.*

completed, in wise anticipation of the necessity that will arise when forest administration is attempted on a large scale*. In India the want of such books made itself felt at an early date. Colonel Beddome who succeeded Dr. Cleghorn as Conservator of Forests in Madras, was the first in the field. His *Flora Sylvatica* of Southern India and Ceylon appeared (1869 to 1873) in three quarto volumes with a large number of good illustrations. In 1874 was published the Forest Flora of North-West and Central India, which had been commenced by the late Dr. Stewart, the first Conservator of Forests in the Punjab, and completed by the writer of these lines. In 1878 Sulpiz Kurz, the Curator of the Herbarium at the Royal Botanic Gardens, Calcutta, whose premature death was a great loss for forest Botany, published a Forest Flora for lower Burma in two volumes. Mr. James Sykes Gamble, formerly Conservator of Forests in Bengal, and now Director of the Dehra Dun Forest School and Conservator of the School Forests, in 1877 published a List of trees, shrubs and large climbers of the Darjiling district and a new edition of this useful little work appeared in 1896. The same author published in 1881 a Manual of Indian timbers, and in 1896 a splendid work with excellent illustrations of the Indian bamboos. Lastly Mr. W.A. Talbot, Deputy Conservator of Forests in the Bombay Presidency, in 1894 brought out a most useful work upon the trees of that part of the country.

It is here the place to mention the "Indian Forester," a Magazine of Forestry, started as a quarterly, and continued as a monthly publication, which was commenced by Dr. Schlich in 1875 and subsequently continued by the Officers who have successively held the post of Director of the Forest School. This periodical, of which 22 volumes have appeared,

**The Silva of North America*, by Charles Sprague Sargent, Boston and New York.

contains a large variety of valuable papers upon Indian Forestry. In other respects also, Indian Foresters have contributed their share to the development of a literature on forest matters in the English language.

Forest Legislation.

As a tentative measure a Forest Act (VII, of 1865) was passed in Sir John Lawrence's time. This Act however was imperfect, and as early as 1869 attempts were made to amend it. As far as I had something to do with this, I had the advice and assistance of my old friend Sir William Markby, at that time Judge of the High Court, Calcutta, and of Mr. B.H. Baden-Powell, the author of the lectures on Forest Law previously mentioned, and afterwards Judge of the Chief Court of the Punjab. However, my business merely was to submit proposals, the Acts were drafted and passed in the Legislative Council, and the result was not always in accordance with the proposals which I had submitted. Forest legislation is an intricate business in all countries, and in India it is particularly difficult. On the present occasion it would be quite impossible to enter into it, and it must suffice to draw attention to the fundamental question, the rights of the State and of other persons in the forests.

The British Government has legally succeeded to the rights actually exercised by the former rulers of conquered or ceded States, at the time of conquest or cession. But the intention of the British Government has always been, to sue these rights, in order to promote the welfare of the people in those territories. It is not here the place to explain, how occupied and cultivated lands have been dealt with; the unoccupied waste, including forests, as a rule was the property of the State. This proprietary right in waste and forest, however, had in many cases been deliberately alien-

ated. Instances are the Zamindari estates created in Bengal under the permanent settlement of 1793, the Talukdars of Oudh, the Malguzars in some districts of the Central Provinces, the village estates of Ajmere-Merwara, as well as the lands sold or leased under the waste land rules. Those waste or forest lands, in which the proprietary right of Government had not been alienated, or where older proprietary rights had not been expressly recognized, as for instance in Malabar, were at the disposal of Government, and upon this is based the provision in the Indian Forest Laws, which authorizes Government to constitute such lands reserved or State Forests.

In these waste and forest lands, however, the people living on these lands or in their vicinity, had grazed their cattle, had cut wood and bamboos, for their use and had cleared land for shifting or permanent cultivation. This customary user of the forest was, it is true, exercised under the old native Governments, subject to the pleasure of the ruling power. Native Rulers in many cases restricted or extinguished this customary user of forest and waste lands. Hence it was not plain at the outset, how the Law should deal with these customs. My deliberate opinion from the beginning was, as has already been stated, that this customary user must be regarded as a right, that the growth of forest right in India had been analogous to the growth of similar rights of user in Europe*. In a paper, which I read at the Meeting of the British Association, Brighton, 1872⁺, I said:

“There has been much thoughtless talk, as if the natives of India, in burning the forests and destroying them by their

*Brandis, *Memorandum on forest legislation proposed for British India*, p.13-Simla, 1875.

+Reprinted from *Ocean Highway*, October, 1872 in *Transactions of the Scotch Arboricultural Society*, Vol VII., p.113.

erratic clearings, were committing some grave offence. If the matter is carefully analysed, they will be found to have the same sort of prescription, which justifies the Commoner in the New Forest to exercise his rights of pasture, mast and turbary. Such rights, when the public benefit requires it, must be extinguished; but the wild tribes of India have the same claim as the holder of prescriptive forest rights in Europe, to demand that provision be made for their reasonable wants and requirements."

This view of the case was accepted, the waste and forest lands therefore were held to be not necessarily at the absolute disposal of Government, but often as burdened with prescriptive rights of other persons. On the other hand I maintained, that Government, as the guardian of all public interests, must insist upon the regulation of these rights, so as to render possible a good management of the reserved forests in the interests of the country generally. I further maintained, that Government must be at liberty to extinguish these rights in any particular forest area, liberal compensation being given for the loss of these rights in the shape of money payment or the grant of land. Hence, when it was decided, to constitute any waste or Forest land a reserved or State forest, it was necessary to invite claimants to come forward in order to prove their rights. The duty of deciding, which claims might be admitted as a right, as well as the regulation and commutation of rights thus admitted, is under the Indian Forest Laws entrusted to special Officers, the forest settlement officers. An appeal from the decisions of these Officers is provided. The Indian Forest Laws, like those of Europe, contain another provision of great importance, viz., that in land duly declared a reserved forest no right can be acquired by prescription.

Upon these principles have been based three principal Forest Laws: The Indian Forest Act of 1878, the Burma Forest Act of 1881 and the Madras Forest Act of 1882. For some districts and provinces, where the Governor General in Council has power to make rules having the force of Law, such as Berar, Hazara, Ajmere, Upper Burma, special Forest Regulations were passed. Under these Acts and Regulations penalties are prescribed for offences committed against the Forest Law and it is a noteworthy fact, that offences punished under the Forest laws have upon the whole not been numerous. This may be taken as a proof that the changes, which the efficient protection and the regular management of the forests have necessarily introduced into the habits of the people in and near the forests, have been made gradually, and as a rule with due regard to their feelings.

Tanning Materials, Caoutchouc, Iron.

Timber, wood and bamboos form what may be termed the principal produce of forests. There are however other products besides these. Bark and leaves of many trees are used for tanning. *Myrobalans*, the fruit of *Terminalia chebula*, is employed for the same purpose, and is exported from Bombay on a considerable scale. Of these substances a permanent and sufficient supply has been ensured by the measures taken for the establishment, protection and good management of public forests in the different provinces. The same may be said regarding the supply of Cutch, the extract of the heartwood of *Acacia catechu*, at least as far as Burma is concerned. Formerly the trees used to be cut wholesale in order to prepare this substance, and at one time the exhaustion of this valuable produce seemed imminent. Since 1876 however large areas of forest, producing this tree, have

been constituted State Forests, plantations of *Acacia catechu* have been made and no apprehensions on this account need now be entertained.

A most important product is India Rubber, the milky juice of *Ficus elastica*. This tree grows north of 24° N.Lat., scattered in the moist forests of Assam, East Bengal and upper Burma. Since these countries have been opened by River steamers, roads and railways, Caoutchouc has become an important article of export from Calcutta and Rangoon. Formerly the trees were tapped wherever found, and the result has been wholesale destruction. In the richest parts not more than 10 to 20 Rubber trees on the square mile exist and when a commencement was made to form State forests in Assam, very few of these trees were left. Nearly the whole of the rubber exported at present, is brought from forests situated beyond the frontier, or from districts, where forest operations have not yet been commenced. Under these circumstances there was no alternative. If it was intended to secure a permanent yield of this article, in future, it was necessary to plant the tree upon a large scale.

Mr. Gustav Mann at that time was Chief Forest Officer in Assam, and it is due to his skill and energy, that between 1875 and 1884 upwards of 900 acres were planted up. In 1884 the Chief Commissioner of the province recommended, that the plantations should not be extended, and that the further development of this industry should be left to private enterprise. The magnificent development of the tea plantations in Assam, after Government had set the example by establishing the first garden in 1835, had shown what can be accomplished by private enterprise in this direction. Nevertheless, there is a great difference. A tea plantation yields an annual return, a few years after it has been formed,

while an India Rubber tree must be 50 years old, before it can be tapped*. Very properly therefore the Government of India at that time declined to accept the Chief Commissioner's recommendation. Operations were continued until 1893, when an aggregate area of 2100 acres had been planted. However, in 1894 the Government of India decided to stop further extension, because doubts were entertained, whether the expenditure would prove remunerative, and further because, even if it were remunerative, many years must elapse, before any profits could be obtained.

And yet it is well known, that the natural resources of Caoutchouc all over the world are gradually getting exhausted, while the article is indispensable for electrical and many other industries. India Rubber has justly been designated as one of the prime necessities of civilization. The demand is increasing, while the supply is diminishing, consequently prices are rising and may be expected to rise further. The annual rubber export from Assam is worth in Calcutta 350,000 Rupees, and the Government royalty on this quantity amounts to 42,000 Rupees a year. This revenue is derived from the extermination of the natural rubber trees, it will diminish and will finally cease altogether. It would seem to be in accordance with common sense, to spend a

*The Mexican Caoutchouc tree (*Castilloa elastica*) yields a return when 8 years old. Accordingly large plantations have been established, for the purchase and working of which, a Joint Stock Company has lately been formed. Apart from the planted forests of *Casuarina* on the Coromandel coast near Madras, the only instance of plantations made by private enterprise in the East, of trees which yield no return, until they the last year or two, of planting forests of the *Gutta percha* tree in North Borneo on behalf of a company interested in the construction of submarine telegraphs.

portion of this income upon extending the plantations, and thus eventually to realize a certain and steadily increasing revenue, and, what is more important, to ensure a permanent and increasing export from Calcutta of an indispensable article.

In many other directions forests might and should be utilized, to develop the resources of India, to a greater extent than has hitherto been done. The old native iron and steel industry has in many districts almost ceased, and this need not have been the case, had more attention been paid to the subject. Steel and wrought iron of the very best description have from time immemorial been made with charcoal in innumerable small furnaces. In order to produce the large quantities of charcoal required, wood formerly was cut in an irregular and wasteful manner, without any regard to the regeneration of the forest. At the same time the growing population required more wood for other purposes and the result was, that in many places the furnaces could no longer be worked. Where however reserved forests have been formed and have been efficiently protected, the position of matters has become completely altered. It has been explained, that protection against fire has gradually changed the condition of the forests. Where formerly they were open, irregularly and incompletely stocked, they are now dense and compact. In this process of improvement the less valuable kinds have profited equally with those which, like Teak and others, yield valuable timber. Yet most of these less valuable kinds, which as a rule constitute the great mass of the forests, furnish charcoal that can be used in iron making. Soon after the changes in the condition of the forests through strict protection had become manifest, it became evident, that the enormously increased production of the inferior woods threatened to become a real difficulty, unless means were found to utilize them. Iron making naturally

suggested itself as likely to help in the employment of these inferior woods and thus to make room for the more valuable kinds.

In many districts, where mineral coal does not occur, particularly in the southern portion of the peninsula, extensive deposits of excellent iron ore are found, haematite in Bellary, and Magnetic iron ore in the Salem district. There is hardly any district in the Madras Presidency and in Mysore, without deposits of iron ore. Between 1824 and 1867 repeated attempts have been made to carry on charcoal iron manufacture on a large scale in the Salem district. These attempts have failed, because no adequate measures were taken to secure a permanent supply of wood to make charcoal. The necessity of having a sufficient area of forest well stocked, efficiently protected and regularly managed, never seems to have been realized by the promoters and Managers of the different Companies that have successively attempted this work. The last year of my Indian Service, from November 1881 to January 1883 I spent in the Madras Presidency and in my Report upon the Forests I submitted definite proposals regarding what should be done, in the interests of the country, to develop the old Native charcoal Iron industry*. My proposals aimed at two distinct objects. First to arrange for the efficient protection and good management of a sufficient area of forest in the vicinity of the old Native Iron works, so as to enable them to continue their operations. Second to attach a competent Metallurgist to the Madras Forest Department, in order to start operations on Government account for the improvement of the Native Method.

It would lead too far on the present occasion, were I to

*Brandis, *Suggestions regarding Forest Administration in the Madras Presidency, Chapter III, Forests and Iron-VIII.: Bellary; IX.: Salem*

enter into detail, and it must suffice to say, that in the opinion of competent experts a substantial improvement of the Native method is feasible. Indian charcoal-iron can never compete with the ordinary kinds of iron and steel which are made with mineral coal. These are now produced in Europe and North America in enormous and steadily increasing quantities and are sold at extremely low prices. Competition with these is out of the question. But Swedish pig iron made with charcoal fetches from 80 to 100 shillings a ton, while English pig made with mineral coal only fetches from 35 to 40 shillings. The object must be, to enable the Native iron smelter, by means of an improved and less wasteful process, to manufacture an article approaching in quality the excellent steel and wrought iron, that was formerly produced on a large scale in Southern India.

No action was taken upon my proposals of 1883 and a paper published in the *Indian Forester* in 1894 on the same subject has also remained unheeded. If not too late, this is a great opportunity for contributing materially to the further development of the resources of India. At the same time, the extended employment of the less valuable woods for iron making, will greatly facilitate the management of many forest districts.

Cattle Fodder

Other substances without number, necessary for the everyday life of the people, and required for the commerce of the world, might be produced in steadily increasing quantities. But the indispensable condition is efficient protection and good management of a sufficient forest area in the different provinces. In a most forcible manner this is illustrated by a most humble produce of the Indian forest, grass and cattle fodder. It has been mentioned above, that the Native chiefs in Rajputana fully appreciated the fact, that in the dry climate of that country a good crop of grass is

produced under the shade of trees, when in the open no grass can live and the ground is bare. And the famine of 1867 to 1869 has taught the lesson, that while the cattle in Kishangarh and Bednore were saved by the fodder furnished by the forest, in the adjoining British territory with its denuded hills, the cattle perished. True, it was difficult to devise a remedy. The State had at settlement relinquished its right over the waste lands. But the people had neglected to fulfil the conditions under which the grant was made.

Colonel Keatinge V.C. who was then Agent to the Governor General in Rajputana, and Commissioner of Ajmere, was strongly impressed with the necessity of taking action and the proposal which I made in 1869 to place the principal ranges of hills, running through the district, under protection, met with his approval. Subsequently, in January 1871, I submitted definite proposals to the Government of India, and again urged action after returning from furlough in 1874. It was the late Sir Charles Aitchison, then Secretary in the Foreign Department, who drafted the Ajmere Forest Regulation, and obtained the consent to it from Lord Northbrook, at that time Viceroy and Governor General of India. This Forest Regulation gave the Chief Commissioner of Ajmere power to take up any tract of waste or hilly land as a State forest, granting the people, who had formerly an interest in that land, the right of cutting grass and wood in it and a liberal share of the net proceeds from the management of such lands. The proprietary rights, which had been granted at the settlement, were thus annulled, but the measure was framed in as considerate a manner, as was possible under the circumstances of the case. At first sight this seemed to be a confiscation of rights deliberately granted. In reality however the waste lands had been granted to the village communities. They were communal lands, and as such public, not private property. Government

therefore, as the guardian of all public interests, had the duty to interfere. Anything like arbitrary action was utterly repugnant to the feelings of my old friend Aitchison, but he saw, the measure was necessary, in order to guard, if possible, against distress and misery in seasons of drought. And this small measure might, if properly followed up, have proved to be one of the most beneficial measures passed in the reign of Lord Northbrook. Action was taken cautiously, and on a visit in December, 1878, I found that 12 tracts aggregating 64,428 acres had been taken up under the Regulation.

The management of these lands was left entirely in the hands of the civil officers, under whom were placed subordinate forest officers. In the commencement a superior forest officer, Mr. McArthur Moir and afterwards Mr. Lowrie, were placed in charge, both however working under the Chief Civil Officer's orders. Mr. McArthur Moir and his successors established an effective system of fire protection, where necessary they fenced in the areas by stone walls or hedges of the fleshy Euphorbia. Dams across watercourses were thrown up and plantations were made in suitable places. On my visit in 1878 I found a great and most satisfactory improvement. In many places young forest had grown up, and grass was everywhere abundant. Since then however very little progress has been made, for in 1895 the area had only been increased to 89,178 acres.

In 1892 another regulation was passed, authorizing Government to establish village Reserves under conditions somewhat differing from those settled in 1874 but only 6,842 acres were taken up under this regulation, so that in 1895 the total area placed under protection amounted to 96,020 acres or 5.5% of the entire area. About one half of the district is in the hands of large land-holders and to the waste land forest included in their estates the regulation does not apply. But had the civil Officers in charge earnestly followed up

the good progress made in the commencement, a much larger area might have been taken up, and the benefit to the people would have been real and lasting. More than this. The villagers had been given the right to cut grass in the reserves. The grazing of cattle however had been prohibited, as this would have prevented the improvement of the forest. The plan was, that only in seasons of drought cattle should be admitted. Instead of this, the greater part of the reserves was after a time opened year after year to grazing. In 1890 and 1891 the rains were scanty and the whole of the reserves, with the exception of 1,182 acres, were thrown open to grazing, in accordance with the original plan. But in 1892-93 the rains were unusually good, yet 56.4% of the area was thrown open; the rains were excellent in 1893-94 and in 1894-95, giving an abundant supply of grass outside the reserves, yet in the first of these two years 58% and in the last 68% were thrown open. This action would seem to have been in accordance with the spirit of orders issued a few years ago by the Government of India, "there is a very special benefit to be derived from a relaxation of the restrictions, that have hitherto been too often imposed upon grazing*."

Doubtless it is more troublesome to cut the grass, than to send the cattle to graze in the forests, but the damage done by cattle, particularly in districts with a dry climate, is out of all proportion to the value of the fodder obtained. The people would be better off, if they relied more upon stall feeding. Grass preserves, where cattle fodder is cut to be stacked and which are rigorously closed against grazing until the grass has been cut, are not unknown in India, they are found even in districts with a moist climate. All around Simla in the North-West Himalaya these grass preserves

*Circular of the Government of India in the Department of Revenue and Agriculture dated 31st October, 1894.

(ghasnīs) on the hillslopes may be distinguished in spring and summer at a distance by their fresh green tint. Generally they are the common property of the village, they are carefully demarcated, all loose stones are removed, and no cattle are allowed inside. At the close of the rains the area is divided among the householders into long narrow strips, generally running down the slope of the hill. Each shareholder cuts the grass on his plot and stacks it for winter use. In autumn, after the hay has been removed, cattle are sometimes allowed to graze on these lands. In the dry climate of Ajmere and Merwara, to throw open the protected areas to cattle, except when necessary in seasons of drought, means that the forest growth upon them does not improve, and that, when their help is wanted, these lands will to a great extent be found barren and useless. In spite of these concessions, the Commissioner reports, that all forest restrictions are thoroughly disliked by the people generally. Added to this a theory had been put forward by the Engineer officers in charge of the tanks, that these would fill better, if the hills were bare. True, trees and shrubs take up a portion of the water which falls, but they also check evaporation of the water not thus taken up, and they prevent the washing down of silt, and in many cases they facilitate the formation of springs, and small rivulets which feed the tanks, not suddenly, but steadily.

The result has not been what it might have been, and what was hoped it would be, when the Forest Regulation of 1874 was passed. In many other places reserves for the production of grass have been established by officers of the Civil and Forest Department, but nowhere has action been taken on a scale commensurate with the great interests at stake. For it must never be forgotten: seasons of drought will always be one of the difficulties of India, and in the districts with a dry climate, in Rajputana, the Punjab, and part of the

North-West Provinces as well as in the Deccan, the provision of cattle fodder in seasons of drought has hitherto been the chief difficulty.

The papers tell us, that during the present distressing scarcity, the result of the short Monsoon of 1896, all forests in the affected districts have been opened to grazing, wherever such was necessary. And it is most satisfactory to learn, that wherever forests had been effectively protected, they are now in a position to furnish an abundance of cattle fodder. The Honble A. T. Shuttleworth, Conservator of Forests, Central Circle, Bombay, the first forest officer who has had the honour of being appointed a Member of the Legislative Council, himself directs the operations for providing cattle fodder from the forests throughout the Presidency. These operations mainly consists in cutting grass and pressing it in 80 lb. bales, which are sold at cost price at depots all over the affected districts. He has made cartroads into the forests, to bring out the grass, and has several hundred presses at work. In previous famines the provision of cattle fodder on an adequate scale was, as a rule, impossible. Thanks to the more complete network of railways, to a good system of organization, but mainly to the improved condition of the forests, that difficulty seems, in the Bombay Presidency at least, to have been overcome, and Mr. Shuttleworth now has the great satisfaction to reap the reward of his indomitable energy, in demarcating and endeavouring efficiently to protect, forest areas of sufficient extent in the different districts of Bombay, when the Indian Forest Act was applied to that Presidency in 1878.

In the Hoshiarpur district of the Punjab the Siwalik range of hills stretches from the Bias to the Sutlej river in a south-easterly direction. These hills consists of conglomerate, a very soft friable sandstone, alternating with strata of loam and clay. Formerly these hills were fairly well wooded. In

1846 they became British territory, the consequence was a rapid increase of population, a great demand for wood and charcoal in the fertile plains of the Hoshiarpur and the adjoining Jalandhar district, and the influx of a floating population of graziers with large herds of cattle. The result was complete denudation of the hills. The loose soil, no longer protected by vegetation, was washed down, broad rivers of sand spread into the plains below, and the end has been, that fields and gardens of 914 villages, once prosperous, are now covered with sand, which has laid waste upwards of 70,000 acres of fertile lands. This rich district is now traversed by numerous parallel sandy belts, cut out of the fertile and crop bearing area, and now rendered worthless.

These destructive rivers of sand, known as the Chos of Hoshiarpur, were first prominently brought to notice in 1878 by Mr. Coldstream, then Deputy Commissioner of the Hoshiarpur district, and by Mr. B.H. Baden-Powell, at that time Conservator of Forests, Punjab. The only remedy possible is to attack the evil at its source, to place these hills under strict protection, to prevent fires, to exclude goats and to regulate grazing and cutting. This portion of the country has a moist climate, a rainfall of 35 to 40 inches, as against 20 to 22 inches in Ajmere and Merwara. Experience has shown in the Saharanpur Siwaliks, that the protection of 4 years only is sufficient to clothe the sides of denuded hills, with coppice shoots, seedling trees, grass and herbs, and thus to control the streams draining them, which formerly used to cover the land below with sand and gravel. Otherwise the difficulty is here the same as in Ajmere. At settlement the waste lands were made over to the villages. But here as in Ajmere, though the State has relinquished its rights the lands have not become private but have remained public property, they are the common lands of the villages.

And the State has not only the right but the duty to interfere, when the management of these lands endangers the prosperity of the country. In 1883 Mr. Mc A Moir was deputed to investigate the subject. He submitted definite and practical proposals, but no action was taken. In 1887 a French Forest Officer, M. Uselle, visited India, and examined one of these torrents of sand near Hoshiarpur. The spectacle to him was simply a matter of astonishment. In France, he remarked,^{*} "we should not content ourselves with looking at the evil and complaining about it, we should take instant measures to stamp it out, we should act and not talk." Volumes have, been written upon the Chos of Hoshiarpur but no useful action has as yet been taken. As in Ajmere, it will probably be necessary to have recourse to legislation, and the people who live upon these hills, and who graze their cattle there, will for a time necessarily be put to some inconvenience. The whole of the land however would not be taken up at once, but gradually, and in the moister climte of this district tracts with good soil and favourably situated, if matters were properly managed, would within a few years be fit to yield ample cattle fodder.

Similar difficulties have presented themselves, and have been successfully met in other countries. In France the deterioration of the slopes in many parts of the Alps, the Cevennes and the Pyrenees, the result of reckless clearances and excessive grazing, had long ago manifested itself in the formation of torrent, the destruction of hill pastures, of fertile fields and meadows in the valleys, which were covered by masses of stones, gravel and sand, brought down by these torrents. A further result of these calamities were disastrous floods in the rivers. The inundations of 1856 and 1859 were extremely severe, extensive damage was done all over the

^{*}Indian Forester, Vol. XIII, p.525

country, embankments and other works of protection had proved useless, and the feeling had become general, that the evil must be attacked at its source. In 1860 and 1864^{*} two laws were passed, which empowered the Government to carry out the necessary works on lands belonging to towns, villages, public institutions and private proprietors, to fix unstable slopes by wires, retaining walls and other structures, and wherever the ground was sufficiently stable, to cover it with turf or to plant it up. These laws were passed under the Second Empire. Action was taken with great energy, and large sums were spent annually upon these operations. At the outset complaints were numerous, but gradually the beneficial effect of these measures made itself felt and progress became steady and satisfactory. Under the Republic agitation against the old laws recommenced, and after protracted deliberations, in the Senate and in the Chamber of Deputies, a fresh law on the same subject was passed in 1882,⁺ considerably curtailing the powers of Government. Under this law the taking up of a new area to be operated upon must be sanctioned by a special law in each case. On communal lands however Government can require the regulation of grazing, and all lands, whether communal or private property, that may require such protection, may be closed against cattle, equitable compensation being paid to the parties concerned. In 1889 the aggregate area successfully operated upon under these laws amounted to 469,000 acres. This however is only a small portion of the total area requiring special protection, and under the law of 1882 operations have become much more expensive. Fortunately a movement has commenced in these mountainous regions, gradually to substitute horned

**Loi du 28 Juillet 1860 sur le reboisement des montagnes. Loi du 8 Juin 1864 sur le gazonnement des montagnes.*

+Loi du 4 Avril, 1882, relative à la restauration et à la conservation des

cattle for sheep and goats, as the cheese made from cows milk pays better. This movement is strongly supported by Government for sheep and goats do infinitely more mischief than cattle.

The good effect of these measures has already brought its reward and though progress has not been as rapid as was originally hoped, the condition of the mountainous districts has greatly improved.

In Austria and Switzerland operations have been carried on in a similar manner and with very marked success.

Most fortunately for the Hoshiarpur district the Government of India have quite lately decided to take action. In referring to the regulation and restriction of grazing in the Siwaliks of the North-Western Provinces, the Government write (2nd July 1896): "In the hills of the Hoshiarpur district in the Punjab, the unrestricted cutting of fuel, the grazing of buffaloes and browsing animals have resulted in the almost total disappearance of wood and grass, and in the most serious injury to the highly cultivated plains below; for the protection of which costly measures are now to be undertaken, the necessity for which might have been avoided, had timely regulation been possible."

The Ratnagiri district on the western coast, south of Bombay, is hilly, but the hills are almost bare to the crest of the ghats. The effect of denudation has shown itself by the silting up of the streams which rise in the ghat mountains, and run a short course to the sea; some of these rivers formerly were important for trade, now they are only navigable for small boats. Excepting the plains, there is hardly a district in India, in the moist as well as in the dry regions where the evil effects of denudation are not visible.

As population augments, as more forest is cleared for cultivation, the difficulty of taking measures to combat these

evils increases. These measures unavoidably, in India as in Europe, involve a certain amount of inconvenience to the present generation, and such interference is felt as a grievance. What is now commonly urged by well meaning but short sighted public officers as "a more lenient forest policy" will, if the Indian Empire remains under British rule, and population continues to increase as at present, carry its own punishment in the shape of serious calamities. In the summer of 1893 the drought in central Germany was extremely scanty, cattle were sold at less than one fourth their usual price, and the cattle which the peasants retained must have perished, had it not been for the forests, chiefly those belonging to the State and to villages. These forests yielded grass and leaves in abundance, but they would not have been in a condition to afford this help, had they been opened to grazing and had they not been rigidly protected in the teeth of the oft expressed serious discontent among the agricultural classes. During the excited times of 1848, when the relaxation of all restrictions was everywhere demanded in Germany, several villages in the Kingdom of Wurtemberg demanded permission to divide their communal forests among the householders of the village. In a weak moment the Government consented, the forests were divided and sold. The proceeds soon disappeared for 1848 was a year of excited popular assemblies, of drinking and carousing in that part of the country. These villages I visited in 1865, and the people complained bitterly of their poverty. The villages in the vicinity, that had put up with the restrictions, which good forest management demands, were prosperous and happy. No communal taxes, for the steady annual forest income paid for roads, lighting, schools and churches, and in addition yielded to each householder firewood in abundance for the winter, and timber for the repair of their houses.

The Dehra Dun Forest School.

The extended employment of native in the forests was urged by me in 1868. In a Report dated 28th July I said: "Ultimately it is hoped, that a large proportion of native forest officers for the higher appointments may be available. It cannot be sufficiently urged, that, unless the practice of rational forest management becomes the common property of the natives of this country, the permanence of the measures now initiated and their ultimate beneficial effects will remain uncertain."* Referring to this Report Sir Stafford Northcote (the late Earl of Iddesleigh), then Secretary of State for India, wrote in a despatch to the Governor-General: 1869 I am glad to perceive that Dr. Brandis appreciates the great importance of interest in employing the natives of India in forest administration, a most important step, as he observes, to the stability of the measures taken with that view."⁺

The plan which at that time I had framed in order to realize these objects, was as follows: The Officers of the protective and executive Branch of the forest service should all be natives of India, while the officers of the controlling branch should be Englishmen, who had received their professional training in the forests of France or Germany. At that time a sharp division between Controlling and Executive officers was not possible. The officers in charge of Forest divisions had necessarily charge of the executive work in the forest ranges included within their division. But eventually, as the management of these forest ranges became more intensive and as the growing revenue permitted such outlay, Rangers would be appointed as executive Officers. These should all be natives of India, they should receive a thorough professional training and should in case of distinguished

*Parliamentary Return on Forest Conservancy, Part I., India, 1871, p.393.

⁺Ibidem, p. 25

service have the prospect of promotion to the controlling branch and of rising to high appointments. At that time I held, what I hold much more strongly at the present moment, that few measures were more likely to secure the maintenance of British Rule in India, than a more extended employment of Natives in responsible positions in the public service. And I considered, that the Forest Department was one of those, in which, without any political risk, the highest appointments might be filled by Natives. In those days I regarded the arrangements for the professional training of young Englishmen as a measure of temporary character, and the establishment eventually of Forest Schools in India as the main object to be aimed at.

At an early date I had fixed upon Dehra Dun at the foot of the North-West Himalaya, as the seat of the future Indian Forest School, and I did, what I could, by personal influence with the local officers, to get a good system of management introduced in the Dun forests, in those outside the Siwaliks in the Saharanpur district and those in Jaunsar and the adjoining leased forests of the North West Himalaya. From the commencement I held, that the teaching at the Indian Forest School must be mainly practical and that in order to make this possible, large areas of well-managed forests must be attached to the School. Fortunately the establishment of a large Military Cantonment at Chakrata in 1869, with an annual consumption of 312,000 cub. ft. of stacked firewood, necessitated the preparation of a working plan for the forests that were to supply that wood. Accordingly I prepared, in November, 1874 and April 1875, with the assistance of the local forest officers, a preliminary working plan, intended to provide for the needful cuttings until 1878. Similar work was done in the other forests which I intended should eventually form the School Forests.

But the idea of a Forest School for Native Forest rangers

at that time found little favour with the leading authorities in India. By many the professional training of young Englishmen for Forest Service was still regarded as a needless, nay as a mischievous attempt at over-refinement. A forester must be a keen sportsman, must have a strong constitution and plenty of common sense. That is all that can possibly be needed in India. To establish a Forest School, in order to give a professional training to Native Forest Rangers, seemed an Utopian beginning. By that time the forest had been made subordinate to a newly created Department of the Government of India of Land Revenue and Agriculture, and my Chief, the Secretary in that Department, Mr. A. O. Hume, C.B., was strongly opposed to the measure. At last in 1878- at the end of a long and severe fight I carried my point with the assistance of several Members of the Government of India, who had confidence in my judgment.

Sanction however was only given on condition, that no additional outlay should be required. This necessitated arrangements which were imperfect and in some instances faulty through excessive economy. Under these circumstances the success of the undertaking entirely depended upon the person selected as Director. Major F. Bailey of the Royal Engineers, had joined the Forest Department in 1871, and had done excellent service, both while in charge of the Dehra Dun Division, as well as subsequently in organizing a special branch of the Service for the topographical survey of the forests, which has furnished at a very moderate outlay excellent maps of the State Forests in several provinces. Under Major (afterwards Colonel) Bailey as Conservator of the School Forests, the area of which now aggregates 516,000 acres, and Director of the Forest School, the management of the forests was steadily improved, the revenue increased, and this made it possible, gradually to strengthen the Staff of Tructors. The leading principle was slow but

steady progress.

In 1881 the first successful students left the School, three with the rangers and two with the Sub. Asst. Conservators' certificate. Subsequently a lower class was established, in which only a forester's Certificate could be obtained. Altogether in 1895, 355 professionally trained men, all Natives of India, the majority belonging to Indian races, had left the School, of whom 273 had obtained the Certificate as Forest Rangers (three of them as Sub. Asst. Conservators) while 82 obtained the Forester's certificate. The students of the lower class, those who prepare for the forester's certificate, come from those provinces in Northern and Central India, where Hindustani is commonly spoken, and to these instruction is given in that language, while the Candidates for the Ranger's Certificate are taught in English. Handbooks in English and in Hindustani for the students of the School have been published and are under preparation. In the Bombay Presidency arrangements have been made at the Poona College of Science, to give candidates for the Forest Service instruction in forestry and natural sciences.

Working Plans controlled by Inspector-General of Forests.

Attention has before been drawn to the fact, that the first attempt to regulate the working of forests by a working plan was made in Pegu in 1856. In later years the writer of this paper was able to prepare preliminary working plans for several districts in other provinces, and Dr. Schlich, while Conservator of Forests in Bengal, prepared working plans for some forests in that province. Obviously, since trees take 100 years and more to attain a marketable size, working plans are indispensable, and regular working plans must sketch out forest operations for a lengthy period. The work

of preparing working plans for the more important forests in all provinces could not be attempted, until a sufficient number of professionally trained officers with sufficiently long experience of the country were available. Dr. Schlich has the great merit of having started this business on a large scale. In order to enable him to control this important work, an Assistant Inspector-General was appointed and the powers of the Inspector-General of Forests were considerably enlarged. All working plans, previous to being sanctioned by the Local Government were submitted for his approval. In other respects also the position of the chief forest officer was greatly strengthened. He was invested with the control of the forest school and forest survey and was authorized, upon professional matters, to correspond directly with Conservators of Forests.

In the early days of forest administration the main point aimed at was, not to centralize but to throw the responsibility of forest administration entirely upon Local Government. In those days it was better that the Inspector General of Forests should have no official authority and that he should be merely the adviser of the Government of India and of Local Governments. His chief duty therefore consisted in visits to the forests in different provinces in company with the local officers. If he succeeded in securing their assent to his own ideas, and if the Local Government approved of his suggestions, well and good. In provinces where this was not the case, the local officers had to be left to their own devices. Progress under these circumstances was unequal in the different provinces. Hence the greater powers, which were given to the Inspector General of Forests, after Dr. Schlich had succeeded me, marked an important step in advance. At first sight it may be regarded as a retrograde step in the direction of centralization. This however was not the case, for by that time the principle of placing Divisional forest

officers under the orders of the Civil district officer, effectually guarded against undue centralization.

One of the most important results of the Dehra Dun Forest School has been, that several native officers, who had received their professional training at that school, are now being employed on the preparation of working plans for important forests, and that their work compares favourably with the work of Englishmen educated on the continent of Europe or at Cooper's Hill College. The present Inspector-General of Forests in his Review of Forest administration in British India for 1894-95 states: "There are many trained Rangers of pure native extraction who yield nothing to anyone." This is a most satisfactory result, and I must claim the indulgence of the reader still for a few further remarks to show, how this result may be utilized, to remove some of the difficulties under which Indian Forestry at present is labouring.

*The Increase of Population necessitates good
Forest Management.*

Within the 10 years which intervened between the Census of 1881 and 1891, the population of the British provinces (without Upper Burma) has increased by 19,365,000* or nearly two millions a year. But not only has the population increased in numbers, it has also increased in wealth. The consumption of forest produce per head of the population is steadily increasing. In towns and villages the people build better houses, requiring more timber and

*1891:221, 173,000 less 2,947,000= 218,226,000

1881	19,365,000
	19,365,000

bamboos. In certain forest tracts the direction of the timber trade has of late years entirely changed. From North Kanara formerly the export of timber was all seawards, and fortunately it was not of great importance and had not exhausted the forests. The export inland was trifling. Since however the Civil war in America, after 1860, had stimulated the cultivation of cotton in the inland districts, a large demand for timber and bamboos for the cotton producing districts of the Southern Maratha country has sprung up and since that time the chief export of timber from the Kanara forests goes in that direction. Similar changes in the lines of timber export have taken place elsewhere in many places. The rapid construction, within the last 40 years of railways, canals and public buildings of all descriptions has created large demands for timber and wood.

The consumption of sugar which, apart from tobacco, is the chief luxury among the native population, is augmenting rapidly, and the cultivation of sugar cane is increasing on a large scale. In his working plan of the Gorakhpur forests (1893) Lala Har Swarup explains, that wood fuel finds a ready market now in that district for brick burning, the manufacture of Saltpetre and for Sugar factories, which in that year numbered 199 in the district. Those forests I visited in 1864, they contain little valuable timber, and revenue from the sale of firewood I regarded as hopeless at that time. Keshavanand, another of the older Native Forest officers trained, at Dehra Dun, in his working plan of the Charda forest in Oudh (1894) proposes to treat this forest with the object of producing a maximum amount of fuel and small timber, all of which can, he adds, be disposed of either locally or to the railway. This forest I had visited repeatedly, in 1863, 1875 and 1880, and the difficulty always was want of sufficient demand for the inferior wood it produces.

There is however no necessity for going into detail. The

steady growth of forest revenue proves the steadily increasing consumption of forest produce in the British provinces.

During the 3 years ending	Mean annual		
	Revenue. Rs.	Expenditure. Rs.	Surplus Rs.
1874-75	6,352,000	4,363,000.	1,989,000
1884-85	10,267,000	6,546,000	3,721,000
1894-95	16,948,000	9,206,000	7,742,000

The export of forest produce beyond India, chiefly Lac, Cutch, Myrobalans and Teak timber, is insignificant. The Teak timber exported from Rangoon and Maulmein 40 years ago amounted to 86,000 tons (at 50 cub. ft.) annually, nearly the whole of which in those days was sent to Great Britain and North America. During the 5 years ending with 1894-95 the quantity exported from these ports had risen to 188,100 tons, but of this quantity only about 45,000 tons were sent to countries outside India. The bulk of the Teak timber exported from the Burma ports now goes to Bombay, Madras and Calcutta, as the forests of the western peninsula are not sufficient to meet the requirements of the older portions of the British Indian Empire. The growth of revenue, therefore, both gross and net revenue, is a true index of the growing consumption of forest produce in India.

It is this steady growth of the population and this steady growth of the requirements of the people in regard to forest produce, that necessitates a regular management of the limited forest area available to meet these requirements. The

aim should be, to produce the largest quantity of timber, bamboos and other produce, on the smallest area possible.

*Extension of Cultivation by relinquishing Land
in the remote Timber Forests.*

A remarkable Resolution on the subject of Forest policy by the Government of India of 19 October 1894, which was published in the Gazette of India and in the Indian Forester.* justly mentions the pressure of the population upon the soil as one of the greatest difficulties, that India has to face, and adds: "that application of the soil must generally be preferred, which will support the largest numbers in proportion to the area." That resolution establishes the following classes of forests, being State property in India, while acknowledging that some forests may occupy intermediate positions and that parts of one and the same forest may fall under different heads:

- (a)Forests, the preservation of which is essential on climate or physical grounds.
- (b)Forests, which afford a supply of valuable timber for commercial purposes.
- (c)Minor forests.
- (d)Pasture lands.

The second class comprises the forests situated in the more remote thinly populated and mostly mountainous districts, with a moist climate, they produce Teak, Sal, Deodar and other valuable trees. Regarding them the Resolution says, that "wherever an effective demand for culturable land exists, and can only be supplied from forest areas, the land should ordinarily be relinquished without hesitation." That this might be done, has been recognized from

**Indian Foresters*, xx., p.414

the commencement of forest demarcation in India. In those districts, where there still existed a large extent of forest at the disposal of Government, very extensive areas were deliberately demarcated, in the hope, that after these forests had been brought into good condition, villages might be established in suitable positions within these forests. The indispensable condition however of this being possible is, so to improve their productiveness, as to secure the same annual supply of forest produce from a smaller area. This end can only be attained by strict protection and regular working. At the time this project was pronounced as fanciful. Localities within the forests, it was said, are uninhabitable, the people settled there will perish of fever. The reply was, that in the wildest forest regions of India we constantly come across evidence, that the land at one time had been under cultivation, fruit trees, ruins of large buildings and terraces of old fields. There is very little of what may justly be called virgin forest in India. Where people once lived and prospered, there they can live and prosper again.

So far regarding the establishment of permanent settlements in the heart of the more remote forests, in order to provide for the surplus population of the open country. It must not however be overlooked, that the separation between forest and the lands allotted to such settlements must be sharp and absolute. A liberal allotment of land must be made to the settlers, but no rights to grazing or other user in the forest must be granted. For it cannot be sufficiently urged, that in forests, which are not completely under the proprietor's control, in which other persons exercise rights of grazing or cutting wood, regular management becomes very difficult.

*Paramount Importance of Minor Forests
and Pasture Lands.*

An entirely different matter is the alienation of lands included in forests comprised under the two last classes, those which are situated in the open country, minor forests and pasture lands. The relinquishment for purposes of cultivation of such forest lands is specially encouraged in the Resolution of 19 October 1894, on the ground of these classes of forests being less valuable than the timber forests. The maintenance and the good management of these minor forests however is of much greater moment for the welfare of the agricultural population in the open country than the maintenance of the so-called valuable timber forests, which are mostly situated in remote mountainous regions. This is the point, which to this present day does not seem to be understood in India.

One of the most densely populated districts under the Lieutenant Governor of the North Western provinces and Oudh is Gorakhpur. This district has already been mentioned. The State Forests here are scattered over the northern and north-eastern portion of the district, there are 14 detached blocks, in size varying from 55 to 26,500 acres. The ground is flat and, though the principal tree is Sal, the timber is small, and these lands would properly be classed under minor forests. They are interlaced with grass lands, likewise included within forest limits, which may be designated as pasture lands. It will be convenient to compare this district with one of the States of the German Empire the Kingdom of Saxony.

	Area Square miles.	Population.	Population per sq. miles	State Forest sq. miles	Percentage of State forest to total area
Gorakpur	4,576	2,994,000	654	172	3.8%
Saxony	5,750	3,783,000	658	652	11.3%

Besides its State Forests the Kingdom of Saxony has 846 square miles of forests, mostly belonging to private proprietors. These also are managed on the same system and as efficiently as those belonging to the State. In Saxony therefore 26% of the total area are occupied by well managed forests, as against 3.8% in Gorakhpur, for the private forests here are insignificant.

The population of Saxony is partly manufacturing, partly agricultural, but had the country not so large an area under well managed forests, it could not possibly maintain its large population. As it is, the forest area is not sufficient for its requirements. Large quantities of timber are imported from Bohemia, partly by land, partly floated down the river Elbe, to provide sawmills, paper pulp factories and other industrial establishments with material. The difference in the condition of the two countries certainly is considerable. Less timber is required for house building and less firewood is consumed in the mild climate of Gorakhpur. But as already mentioned there are considerable wood-consuming industries in the district. And this equally applies to the two adjoining districts, which, with Gorakhpur, form the Division of that name, Basti with 645 Souls on the Square mile and Azamgarh with 805. These two districts have no forest at all at present. The area under sugar cane alone in these three districts in 1895 aggregated 201,161* acres and the manufacture of sugar consumes large quantities of firewood. In 1864, as already mentioned, a revenue from the sale of firewood seemed hopeless, now the whole produce sells readily. Gorakhpur has a mean annual rainfall of 49 inches, and the district is extremely fertile. Of the area under crops one half nearly are rice fields.

If peace is maintained in India, it will ere long be found,

**Agricultural Statistics of British India, 1890-91 to 1894-5, Calcutta, 1896, pages 149-151*

that in this district the forest area is much too small, and if not too late, efforts will then doubtless be made, to increase it. Fortunately, a large area of waste land, partly culturable, partly unfit for cultivation, is available, amounting in 1895 to 1,034 Square miles or 22.6% of the total area, and much of this is covered with grass, trees and brushwood. A most valuable reserve for the gradual extension of cultivation, but at present its produce is worth very little.

The difference between the two countries is this: In the Kingdom of Saxony 26% of the total area is forest efficiently managed, while 74% are cultivated, hardly an acre lying waste. Gorakhpur maintains about the same population on the Square mile. Of its area 73.6% are cultivated, 3.8% well managed forest and 22.6% are waste. In both cases, of the cultivated area, there are 0.72% acres per head of the population, but, while in Saxony the uncultivated area (26%) is well managed forests, every acre of which yields useful produce, in Gorakhpur 22.6% of the district is permitted to lie waste. True, these lands are used for grazing, and a little wood is cut here and there, but they do not yield what they might, if placed under proper management. Cattle fodder alone might be produced more abundantly on a much smaller area. Certainly, in the mild climate of Gorakhpur less firewood is required, than in the cold winters of Germany. But even here it would be prudent before it is too late, seriously to consider, what portion of the waste should be added to the forest area, in order to make sufficient provision for this as well as for the adjoining forestless districts. So much will be clear from what has been stated, that even in a favourably situated district, like Gorakhpur, the point to be aimed at, is not to relinquish any portions of the forest area for the extension of cultivation, but rather to enlarge that forest area, and to diminish the unproductive area of waste lands. Afterwards, if it should be found necessary, to

break up land for the plough, it will be found, that fields, which had been stocked with forest, are more fertile than the present barren waste.

The gigantic size of the British Indian Empire is fitly illustrated by the fact, that we have compared one of the larger States of the German Empire with one of the 49 districts in the North-West Provinces. It is also illustrated by the following comparison of the British provinces with the entire German Empire.

	Area		population per square mile	Percentage	
	Square miles	Population		State Fore- st Square mile	State Forest area to total area
British provinces					
of India	964,993	221,173,000	229	74,271	7.7%
German Empire	208,687	52,246,000	250	17,918	8.6%

At first sight these two large countries, which maintain nearly the same number on the Square mile, though they are widely different in regard to configuration of the country, climate, vegetation and the habits of its inhabitants, would seem to be nearly on at par in regard to Forest management. In reality however this is not the case. In the German Empire, as in the Kingdom of Saxony, the forests belonging to towns, villages, public institutions and private proprietors are as a rule as well managed as those of the State, and these aggregate 35,970 Square miles, so that the area of well managed forests amounts to 25.82% of the country. In the British provinces of India, besides the reserved forests entered in the above Statement, the returns include 7,090 Square miles of protected and 31,591 of unclassed State forests, but protection and management of these tracts is not such as to justify our taking them into account.

Establishment of Village Forests.

Besides these areas however, which are classed as forests in India, there are in each province large areas of waste, aggregating 390,000 Square miles, or considerably more than one third of the whole area. It has above been explained, that eventually it may be advisable, in the extensive and remote timber forests to establish villages and there to relinquish land for cultivation. At the same time however attempts must be made upon an adequate scale in each province, to improve the productiveness of these large areas of waste lands, and where the nature of the land tenure admits of it, to establish village forests. The formation of grass and fuel preserves has been the first step in this direction. To this class belong the reserves in Ajmere-Merwara. Attempts more or less successful have been made here and there in the North-West Provinces. The object is to produce heavier crops of firewood and grass in the open cultivated country. It has now been sufficiently established, that strict protection, aided by sowing and planting, during a number of years longer or shorter, according to the climate, produces a covering of shrubs and grass and yields a crop of cattle fodder, which at first must be utilized by cutting, while afterwards cattle may be permitted to graze during certain seasons.

It is immaterial, which agency is employed in these operations. On the banks of Canals the Officers of the Irrigation Department look after these areas, elsewhere the work may be done by the Civil or Forest Officers. All I wish to say is, that there exists an agency of Officers specially trained for work of this kind, whom in most cases it may be found useful to employ. Native Forest rangers, who have received their professional education at Dehra Dun, ought to be specially fitted for these undertakings, working under

the direction of the Collector of the district.

It may be useful, once more to mention the Azamgarh district, which adjoins Gorakhpur on the South. A poor densely populated district with 805 souls on the Square mile. The area cultivated in 1894-95, together with regular fallows, amounted to 886,000 acres,* giving only 0.51 acre per head as against 0.72 acres in Gorakhpur and Basti. Fortunately however no less than 501,000 acres of crops were irrigated, a much larger percentage than in either of the two adjoining districts. Nevertheless the people are poor, living mostly from hand to mouth, and dwelling in miserable huts of dried mud. The waste lands aggregate 490,000 acres or 35% of the total area. But there are trees in the ravines (*Butea* and *Acacia arabica*). Here is a promising task for a skilful forester. There are special difficulties, extensive marshes and usar lands, impregnated with salt. The plan ought to be, to take up block after block and thus gradually to convert a portion of these waste lands into productive forest, the object being, at first to produce an abundant supply of firewood and cattle fodder, and eventually small wood, to enable the people to build better houses, and for agricultural implements. The first step must be, to make the waste land produce more than it does at present, and the second to give up from the improved waste land such portions, as may be suitable for the extension of cultivation.

In his Report on the improvement of Indian Agriculture, Dr. Voelcker justly urges the establishment on a larger scale of fuel and fodder reserves, for the primary purpose of supplying wood to take the place of cow dung as fuel. "If wood," he says,** "could be made to take the place of dung"

**Agricultural Statistics of British India 1890-91 to 1894-95, Calcutta, 1896 page 58.*

***Voelcker, London, 1893, p. 137 Report on the Improvement of Indian Agriculture.*

for fuel, we should soon come to realize, that more "wood means more manure, that more manure means heavier crops, and an increasing fertility of the soil."

With the view of an eventual development in this direction, clauses providing for the establishment of village forests were inserted in the Indian and Burma Forest Acts. Experience has shown in Germany, in France and in other countries of Europe, that municipal institutions develop in a healthy manner, where the municipalities have landed property. In the case of municipal forests it has in these countries been found expedient, to entrust the State with a supervision of their management. The necessity for such supervision is obvious, and should waste lands in India ever be transformed into village forests, the same plan will doubtless be followed.

Perhaps these ideas will be put aside as the outcome of Departmental zeal, which always trenches upon the traditions of the Native population, their cherished customs and privileges. But the British Nation has undertaken the responsibility for the millions inhabiting this huge Empire, that population is increasing rapidly and steadily. A long period of internal peace, security of persons and property, good government the impartial administration of justice, the development of commerce, manufactures and agriculture, canals and other irrigation works, roads, railways, and, by no means least, schools and colleges – all this has brought about a tide of progress which cannot now be stemmed. There is no help for it, whether the work is done by Departments of the public service or otherwise, the clock cannot be put back. But the blessings of progress will be valued more by the people, if they are not all dispensed by the hand of the Foreigner, if Natives themselves are the agents to a greater extent, than is the case at present, in the undertaking which contribute to their well being. A well

planned system of making the waste lands in the different provinces more productive than they are at present, is one of the great points that should be aimed at. This work however ought as far as possible to be entrusted to Native agency.

The Difficulties of the Task must be faced.

All the world over people living in the forests or in their vicinity, feel the commencement of strict protection as a hardship, howsoever considerate the settlement of forest rights may have been. Old customs are more comfortable, the interests of the present moment more powerful, than care for the future. Not everywhere may it be possible, by giving them opportunities of earning money through forest work, and by supplying their wants in a liberal manner, to gain the goodwill of these people, as has been the case with the Karens in Burma.

This however has been possible in other provinces also, and as an instance I will quote the following passage from a Review of the Berar Forest Report for 1892-93 by Colonel Kenneth Mackenzie, the Commissioner of that province. In 1865 Mackenzie as Assistant Commissioner, acting under the orders of Colonel Pearson, then Conservator of Forests Central Provinces and Berar, organized forest business in Berar. In 1893 he writes as follows: "Intimately connected with the welfare of the forests is the prosperity of the people in and immediately around our reserves, their well being, on which follows their goodwill depends on the wise adjustment of our forest concessions, to their necessities. Luckily our position, especially in the Melghat, enabled us to be liberal, with the result, that the people in the hill tracts are well affected towards us. They practically form an unpaid protective force, of great value, in addition to our own staff.

Without their ready and willing assistance, our great success in fire conservancy would have been impossible."

The real strength of the gigantic British Indian Empire consists in the prosperity and contentment of its inhabitants. The British Nation may well be proud of having accomplished this – of having established a strong, just and considerate Government among the numerous nationalities of British India. At first sight it seems an impossible task, to secure the contentment of the people, while interfering with their habits, however great the future benefits may be, that will result from such interference. Nowhere in the world has there been real and important progress without temporary dissatisfaction. In India also means must be found, that will enable Government to provide for the future welfare of the steadily growing population, in spite of the temporary discontent its action may cause.

Native Forest Officers must be employed in responsible appointments.

A minute written by Sir Thomas Munro, when Governor of Madras, on 31 December 1824, on the employment of Natives in the public service, suggests the measures which should be taken. He writes: "All offices that can be held by natives without danger to our power, might with advantage be left to them*" and further on follow remarks to the following effect. "To improve the character of the "natives, we must open the road to wealth and honour and "public employment."

The best plan which can be suggested, in order to mitigate the friction which is the unavoidable consequence of strict protection and a regular system of working, is to

*Sir Thomas Munro, Bart, K.C.B., by Sir Alexander J. Arbutbnot, Vol. II. London, 1881, page 319.

employ as many competent and professionally trained Native forest officers, not only in subordinate but also in responsible positions. It is not maintained, that Native Forest Officers will necessarily be more considerate than Englishmen. But in any case it cannot be said against them, that they lack the perfect knowledge, the deep insight into and the sympathy with the feelings and prejudices of Asiatics. One point is certain, they will be able, with greater force to insist upon the advantages which the people actually derive from well managed and efficiently protected forests, more abundant and permanent supply of forest produce, heavier dew on the fields in the vicinity, and shelter against scorching winds. The larger the number of natives employed in responsible positions in the forests, the more forestry will cease to have the character of an exotic plant, or a foreign artificially fostered institution. In order however to attain this object, it will be necessary greatly to strengthen the Staff of the School forests attached to the Dehra Dun School, and eventually to establish similar schools in other parts of the country, particularly in Burma.

Against these proposals it may be urged, that in Ajmere-Merwara the chief forest officers have during the last five or six years been natives of India of Asiatic extraction, and that nevertheless the majority of the reserves have been annually opened to grazing. This however was the Commissioner's order. An English Officer in responsible positions, will make it easier for Government to do its duty, with due regard to the future development of the British Indian Empire.

The measure here advocated must not be expected to yield great results at once. If decided upon, it must be carried out cautiously but steadily. The aim should be, gradually, in a few carefully selected districts, say in Berar or the Central Provinces, to fill all appointments with pure natives of India, and when this has proved, a success, to proceed further. It

will be a great point gained, when the first Native is appointed to the post of Conservator of Forests in Berar or in one of the Forest Circles of the Central Provinces. There is at present an Imperial Forest Service which is recruited from Cooper's Hill and a Provincial Service which is recruited from Dehra Dun, and for Bombay from the Poona College of Science. Under existing orders members of the Provincial Forest Service can rise to the rank of Extra Deputy Conservator on 600 Rupees a month, but when the measures here advocated have been adopted, their prospects must, as a matter of course, be improved. Professional education must lead to an honourable and paying career. This once clearly established and publicly known, desirable and promising Native candidates will not be wanting, and upon the Indian Forest Schools will then mainly rest the duty of preparing men for forest work in India. However, the difficulties are not slight, and it is best to face them. In the Review of the Berar Forest Report previously quoted, Colonel Kenneth Mackenzie says: "There is very great difficulty in getting physically fit and suitably educated young men now to enter the ranger's grade, and every body who is acquainted with the facts in the background, will agree that a potent cause for this is the comparatively poorer prospects, that such men at present have in the forests, as compared with openings, in other Departments. Consequently it will certainly pay Government directly and indirectly to improve their position. I do not think that the hard work, the loneliness, the sickness, that these men have to face, comes home in any thing like the reality to those ultimately responsible for their welfare, as it does to those who, like myself, are continuously brought into intimate relation with facts. It fell to me, as Assistant Commissioner in 1866, nearly 28 years ago, to select and demarcate our main reserves and to start, under the direction of Colonel George Pearson, what is now the Berar Forest

Department – and of all the men I then enlisted, with one or two exceptions all young men of excellent physique, and locally climatized, but two now survive."

Another difficulty is adverted to by Mr. E.P. Dansey, an excellent officer of long experience. As Conservator of the Central Circle, North West Provinces he wrote in his Report for 1894-95: "The most unprofitable of all subordinate forest officers is the townbred school boy educated at Government expense in the rudiments of his profession, and who has had no long previous experience of jungle life, jungle tribes and jungle conditions generally,"

These extracts indicate some of the breakers ahead. When the Forest School was started, it was laid down as a rule, that no student should be received, who had not proved his fitness for the forests by several years' work as a volunteer or as a forest guard. This rule it has apparently not been possible to maintain. So much however is certain, no students of the desirable classes will present themselves, unless they can look forward with certainty to good prospects of advancement.

Something has already been accomplished in Native States in this direction. A considerable number of smaller and a few larger States have imitated the example of the British Government, they have organized the administration of their forests, and in several instances men, who had received their professional training at Dehra Dun, have been placed at the head. Mysore has a completely organized Forest Department. The present Conservator is Colonel Campbell Walker, formerly Senior Conservator of Forests, Madras, but under him are 14 Divisional Officers, all natives of India, and most of them natives of the Mysore State. In the Jammu and Kashmir State, Forest administration is making very good progress under Mr. McDonell, the Con-

servator of Forests. In the large Rajput States of Marwar and Jaipur the Conservators of forests have from the commencement been Native Gentlemen trained at Dehra Dun, and they have done remarkably well in that position. If forest service, be it in British territory or in Native States, once comes to be recognised as offering an honourable career, that may, as the reward of honesty, skill and energy, lead to high and well paid appointments, forestry will become naturalized in India and will cease to be looked upon as an attempt to introduce Foreign ideas and Foreign practices.

These plans are not new. Attempts to appoint Natives of India to responsible posts in the Forest Department were made many years ago, long before the Dehra Dun School was established. These attempts have failed, because they were ordered to be made suddenly, and without the needful forethought. The measures here advocated must be allowed to develop slowly, but steadily, towards the point aimed at.

The proposals here made, gradually to employ Natives in responsible positions of the Indian Forest Department, have been made on one condition, and this condition is absolute, viz., that they have received an ample, thorough, practical, and theoretical training in their profession. Several times of late years the attempt has been made, to alter the constitution of the Dehra Dun Forest School, and to remove the School forests from the Director's control. The Director of the School is and must be Conservator of the School Forests. This large forest area must be entirely under his control, establishments for the management and protection of it must be provided upon a liberal scale, the Divisional and Executive Officers, the Deputy Conservators and Rangers of the School forests must all be picked men. If this principle is not maintained, the employment of men trained at the School in responsible positions, is out of the question. Nay more is required. The Cooper's Hill forest students now

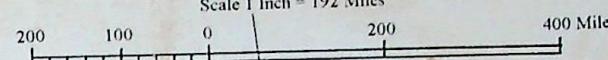
most properly spend a considerable part of their time in Germany. One of the advantages of this arrangement is, that it enables them, while in India, to remain in touch with the progress of forestry in Germany. No officer, who aspires to the high position of Conservator of forests, ought to be ignorant of what goes on in his profession in those countries of Europe, where it has attained its greatest perfection. A large number of young men from Japan are now in Germany, studying at forest schools, at Universities and other institutions. If Dehra Dun is maintained and strengthened as it ought to be, it will hereafter come to be considered, how to enable Native Forest Officers, who have distinguished themselves in actual service, and who are anxious to rise further, to spend some time in the Forests of Germany. There they will find, that the villages, which own well managed communal forests, are prosperous, although now and then they may complain of the restrictions, which a good system of management unavoidably imposes. What Indian Forest Officers will learn in this respect in Germany, will be really useful to them in India.

Fanciful ideas, the reader may say, some indeed may call them Utopian. Thus was designated in 1860 the attempt, to work the Pegu forests on Government account, and to ensure from them a permanent and increasing yield of Teak timber. Fanciful and impossible was pronounced in 1865 the attempt to protect the forests against the annual jungle fires. When in 1867 the professional education of young Englishmen was started in France and Germany, and when in 1878 the Dehra Dun Forest School for Native students was established, these undertakings were regarded by many as useless and preposterous. We will comfort ourselves with the hope, that the employment of Native Forest Officers in responsible, nay in high positions, will some day be recognized as the only proper course to pursue.

LIMITS OF THE DISTRIBUTION
OF THE
PRINCIPAL KINDS OF TREES
1895

1895

Scale 1 Inch = 192 Miles



**LIMITS OF THE DISTRIBUTION
OF THE
PRINCIPAL KINDS OF TREES
1895**

Scale: Inch = 192 Miles
200 100 0 200 400 Miles

28°
20°
12°

REFERENCE

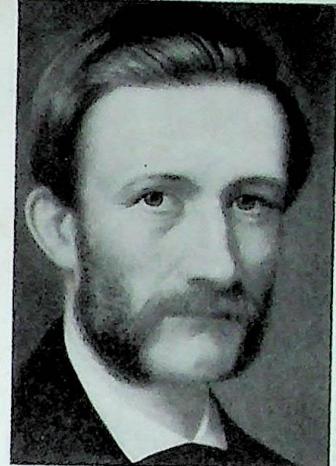
- Limit of Teak - (*Tecknia grandis*).
- Do. " Sal - (*Shorea robusta*).
- Do. " Deodar - (*Cedrus deodara*).
- Do. " Caoutchouc - (*Ficus elastica*).
- Do. " Red Sanders - (*Pterocarpus santalinus*).
- Do. " Sandal - (*Santalum album*).
- Do. " Cutch - (*Acacia catechu*) for Burma only.

REFERENCE

1	Limit of Teak - (<i>Teclona grandis</i>).
2	Do. " Sal - (<i>Shorea robusta</i>).
3	Do. " Deodar - (<i>Cedrus deodara</i>).
4	Do. " Caoutchouc - (<i>Ficus elastica</i>).
5	Do. " Red Sanders - (<i>Pterocarpus santalinus</i>).
6	Do. " Sandal - (<i>Santalum album</i>).
7	Do. " Cutch - (<i>Acacia catechu</i>) for Burma only.

If my view is
that the law
while unable to stop
from Russia's
~~Centra~~
The proprietor was
duty on the
use of his
property for his
timber
compelled to
when growing upon
his own
and does not affect
but by

of our dog
for purposes
does not affect
the however unless it is perfectly
dried dog.



Sir Dietrich Brandis (1824-1907), father of tropical forestry and India's first Inspector General of Forests, made a monumental contribution to forestry in India, Pakistan, Bangladesh, Africa, Europe and the U.S.A. He authored more than 250 books, research papers, reports and articles both in English and German.

Brandis was of the view that Indians should man all levels of the forestry science in India. With this in mind, he selected Dehra Dun to be the seat of the proposed Indian School, meant for training Indians in forestry.

Brandis toured the length and breadth of the subcontinent, formulating management plans and silvicultural treatments. After serving with the Indian Government for 19 years he returned to Europe where he continued to shape the future of forestry in India and many other countries.

FORESTS : THE ECOLOGICAL RAMIFICATIONS

A.P. Dwivedi

Foreword - A.K. Mukerji

This book, the first of its kind is a bible on India's Forests. It contains everything you wanted to know about them but did not know where to look. A standard reference tool for anyone interested in forests & the science of forestry.

INDIA'S FORESTS : MYTH & REALITY

J.B. Lal

Foreword - B.G. Vergese

The state of Forests in India-the book contains information on the geographical variability historical back-ground, socio-economic constraints, silvicultural practices and the ecological perception that have helped shape the forests. The book presents a comprehensive picture of forests & forestry in India.

FOREST ECOLOGY

J.B. Lal

Foreword - Maneka Gandhi

Forest ecology is the most complex of disciplines, for the forest may be viewed as million species each distinct and yet not separate, depending as it does on existence of at least a hundred or so others. The whole far exceeds the sum total of its many parts. Again complexity must not be such as to defeat analysis and in the study of forest ecology the traditional processes of analysis such as categorization or division into groups, interaction between groups, generalisation based or averages are liberally applied so as to achieve understanding of what would be otherwise a defeating and intractable problem.

THE FUTURE OF WORLD FORESTS

Their use & Conservation

Kilaparti Ramkrishna & George M. Woodwell

The continuous destruction of forests around the world contributes to global warming and to systematic and progressive impoverishment of land and people. In this book, scientists, legal experts, and economists document the importance of forests in the working of the biosphere and define the issues involved in using and protecting the great forests of the earth.

THE FUTURE OF PROGRESS

Reflections on Environment & Development

Vandana Shiva, Helena Norberg-Hodge, Edward Goldsmith & Martin Khor

Contributors to this volume challenge the assumption that West is best-head on, and thereby challenge the very foundations of modern development. The imposition around the world of a single industrial monoculture will they argue, inevitably lead to increasing social and environmental breakdown. Only by respecting the biological diversity can we move towards a truly sustainable and equitable pattern of living.